THE RIVER BASIN WATER QUALITY MANAGEMENT PLAN FOR KENTUCKY

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CHAPTER 1

INTRODUCTION

KENTUCKY RIVER BASIN

Project Purpose

In 1972, the Congress of the United States enacted Public Law 92-500 entitled the Federal Water Pollution Control Act as Amended. As part of this act, and subsequent regulations, each state is required to develop a continuing water quality planning process, the goals of which are to: (1) provide the state with water quality assessment and program management information necessary to make centralized and coordinated water quality management decisions; (2) encourage water quality objectives which take into account overall state policies and programs, including those for land use and other related natural resources; and (3) provide the strategic guidance for developing the annual state program submitted under Section 106 of the Act.

The Water Quality Management Plan for the Kentucky River Basin is one of ten being concurrently prepared for the major drainage basins in Kentucky. The plans are being prepared for the Division of Water Quality, Kentucky Department for Natural Resources and Environmental Protection in conformance with Section 303(e) of Public Law 92-500 and applicable guidelines. The individual river basin plans establish specific programs and targets for preventing and controlling water pollution in specific river basins and establish policies for guiding water quality management decisions over a five and twenty year period.

This plan is a compilation and analysis of data from numerous sources which will serve as a base or foundation document for the State's continuing water quality management process for the Kentucky River Basin. It is envisioned that information contained in this document will be adapted to a computer filing system allowing continuous updating and data expansion regarding water quality analysis.

Past Water Quality Management Planning

Comprehensive water quality management planning has never been carried out on a statewide basis in Kentucky. Water quality programs within the various divisions of state government having a responsibility to water quality management were in the past extremely fragmented until the recent reorganization brought many of them together in the Department for Natural Resources and Environmental Protection. In addition, past efforts in developing comprehensive water quality planning suffered in part due to a lack of funding and competent trained personnel.

The thrust of past water quality management in Kentucky has been primarily in the areas of enforcement of state laws and regulations governing wastewater treatment plant plans, review and approval and field inspection of municipal and industrial waste treatment facilities, and inspection of oil field and coal mining operations. Monitoring of water quality was carried out at a few locations scattered throughout the state; however, the extent of this effort was extremely limited.

Kentucky's fifteen Area Development Districts (ADD's) have each prepared a water and sewer plan for their area of jurisdiction. However, these areawide plans were not prepared utilizing a river basin concept nor were they standardized in content. Some ADD water and sewer plans were developed in great detail while others were much more broad in scope. In spite of their great divergence in quality and content, the ADD plans do contain a great deal of data which was useful in the preparation of the Kentucky River Basin Plan, and do represent an initial effort at regional water quality management planning in Kentucky.

The state legislature has given some recognition to the extremely costly features of wastewater management with the creation of the Kentucky Pollution Abatement Authority. As the result of an amendment to the basic Enabling Act of the Authority, passed by the 1974 General Assembly, the Authority is able to assist in financing the entire local share of municipal sanitary waste facility construction programs in Kentucky.

The Corps of Engineers' planning has, until the recent past, been relegated to flood control and management of rivers with respect to navigation. However, the Corps has cooperated very closely with state agencies in the development of their projects with due regard to water quality objectives. Within the Kentucky River Basin the Corps is currently involved in an Urban Studies effort within the Lexington area which will fulfill many of the requirements of a 208 Areawide Waste Treatment Management Plan.

The U.S. Geological Survey (USGS) has established numerous gauging stations for determining stream flow in Kentucky. The stations primarily reflect stream flow or contents of a reservoir. Although the data are useful and necessary for water quality management, they are but one facet of a comprehensive water quality management program. USGS has also collected data on water quality at specific locations within the Kentucky River Basin. The most comprehensive collection of water quality data within recent years has occurred at Frankfort, Kentucky, where specific data on chemical quality, water temperature and sediment have been obtained. Although Biochemical Oxygen Demand (BOD) and Dissolved Oxygen (DO) data have not been measured, the information accumulated by the USGS is invaluable and represents a portion of the total data needed for the formulation of an effective water quality management plan.

The Soil Conservation Service of the Department of Agriculture has accumulated considerable data relating to land use, including erosion characteris-

tics, and suitability of land for receiving effluents from wastewater treatment plants. This data is also extremely useful and should become a part of the total management scheme for effective water quality management.

Other official agencies, such as the Department of Housing and Urban Development, Appalachian Regional Commission, and Economic Development Administration have assisted in financing the construction of wastewater collection and treatment facilities, an important facet of any water quality management program. Finally, the U.S. Environmental Protection Agency, (EPA) and their predecessors have provided substantial funds for on-going state programs, and the construction of wastewater treatment works.

EPA has also provided guidelines and funds for planning including 201 Facilities Planning, 208 Areawide Waste Treatment Management Planning, and 303(e) River Basin Planning.

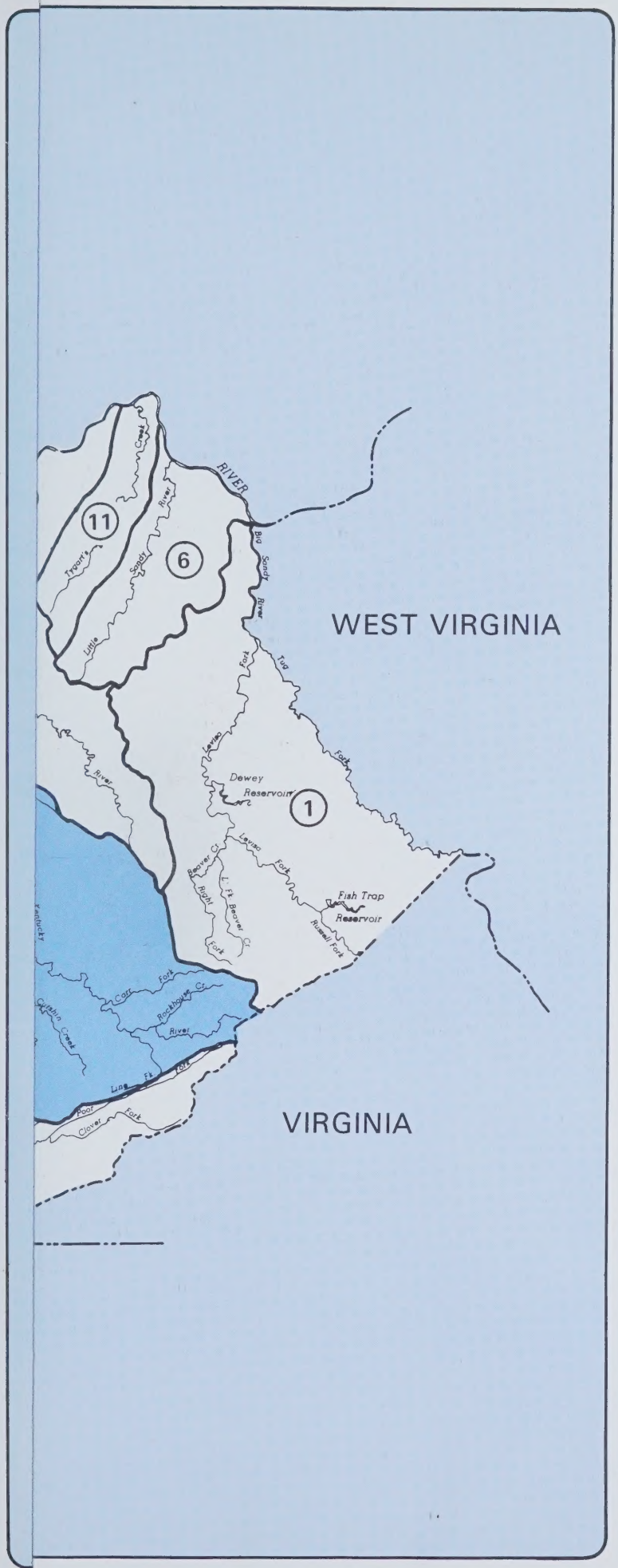
All of the agencies discussed above have contributed to water quality enhancement, and although cooperation has been exercised among the various agencies, the development of a comprehensive river basin plan for water quality management has not become a reality until now.

Kentucky River Basin Location

The Kentucky River drainage basin, which lies wholly within the State of Kentucky, includes all or portions of 39 of the state's 120 counties. The river rises in the mountainous terrain of southeastern Kentucky and flows in a northwesterly direction through the central part of the state to its junction with the Ohio River at Carrollton in North Central Kentucky. The main stem of the Kentucky River is 255.5 miles long from its mouth to the confluence of the North, Middle and South Forks near Beattyville. Other major tributaries of the Kentucky River include Eagle Creek, Elkhorn Creek, Dix River and Red River (See EXHIBIT 1.1m).

The total drainage area for the Kentucky River Basin is approximately 7,000 square miles. For discussion purposes in this report, the basin will be divided into two sections based on the dominant terrain features. The first is the "Headwater Section" which includes the North, Middle and South Forks, as well as 37 miles of the main stem to the City of Irvine. The Headwater Section contains over 2,900 square miles of rugged terrain in the Mountains and Eastern Coal Field Physiographic Region. The remainder of the basin will be referred to as the "Bluegrass Section"; it includes tributaries draining over 4,100 square miles of rolling to steep terrain of the Bluegrass Physiographic Region.

The Kentucky River Basin includes portions of seven different Area Development Districts, shown in EXHIBIT 2.2m. Most of the basin is included within the Bluegrass and the Kentucky River ADDs, with smaller areas falling within the Cumberland Valley, Gateway, Lake Cumberland, Jefferson (KIPDA), and Northern Kentucky ADDs. Surface area for each of the 39 counties within the basin is presented in Appendix A-7.



KENTUCKY RIVER BASIN

EXHIBIT 1.1m

BASIN LOCATION

LEGEND

KENTUCKY DRAINAGE BASINS

1	BIG SANDY
2a	LOWER CUMBERLAND
2b	UPPER CUMBERLAND
3	GREEN RIVER
4	KENTUCKY RIVER
5	LICKING
6	LITTLE SANDY
7	MISSISSIPPI
8	OHIO MINOR TRIBUTARIES
9	TENNESSEE
10	TRADEWATER
11	TYGART'S CREEK
12	SALT RIVER

10 0 10 20 30 40

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

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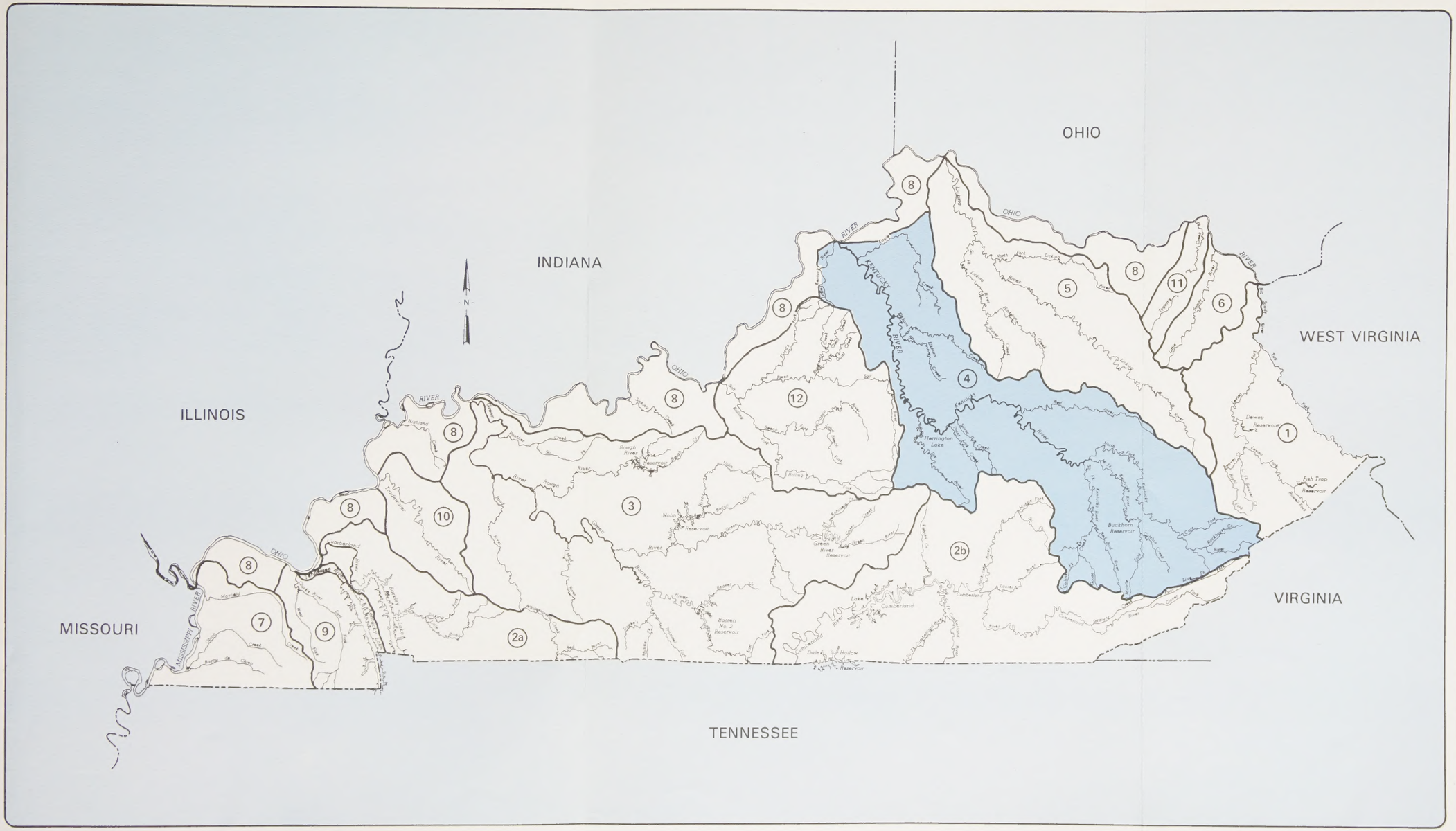

KENTUCKY RIVER BASIN

EXHIBIT 1.1m

BASIN LOCATION

LEGEND

KENTUCKY DRAINAGE BASINS

1	BIG SANDY
2a	LOWER CUMBERLAND
2b	UPPER CUMBERLAND
3	GREEN RIVER
4	KENTUCKY RIVER
5	LICKING
6	LITTLE SANDY
7	MISSISSIPPI
8	OHIO MINOR TRIBUTARIES
9	TENNESSEE
10	TRADEWATER
11	TYGART'S CREEK
12	SALT RIVER

10 0 10 20 30 40

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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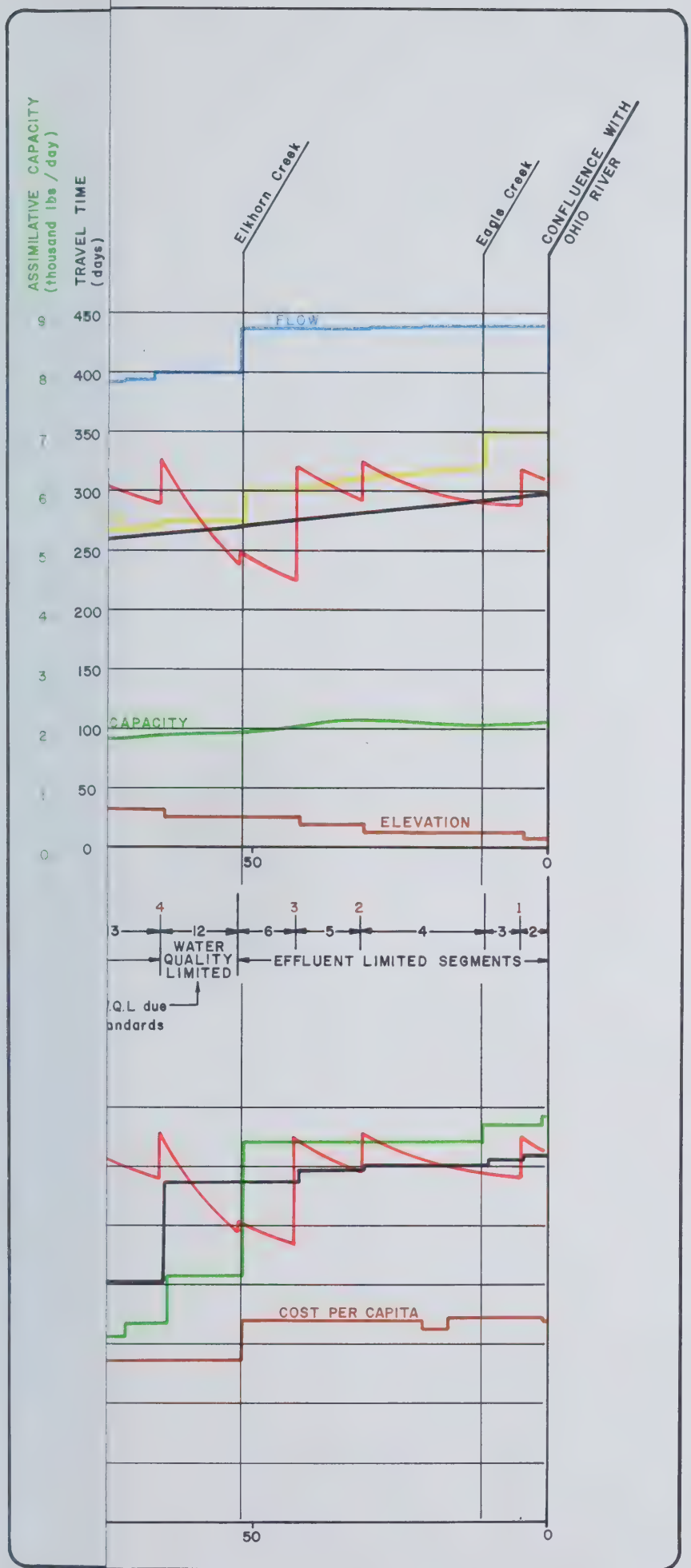

KENTUCKY RIVER BASIN

EXHIBIT

BASIN LOCATION

LEGEND

LOCK AND DAM NUMBER 14

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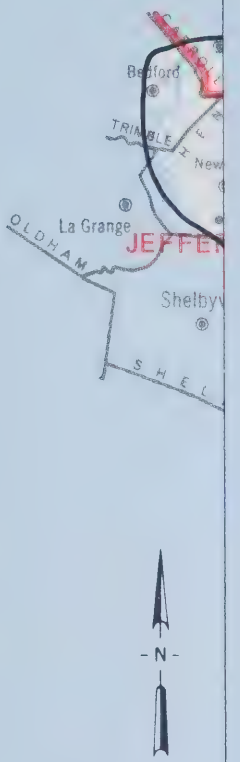

KENTUCKY RIVER BASIN

EXHIBIT 1. 2m

AREA DEVELOPMENT DISTRICTS

LEGEND

AREA DEVELOPMENT DISTRICT BOUNDARY

10 0 10 20 30 40

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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KENTUCKY RIVER BASIN

EXHIBIT 1. 2m

AREA DEVELOPMENT DISTRICTS

LEGEND

AREA DEVELOPMENT DISTRICT BOUNDARY

10 0 10 20 30 40

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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CHAPTER 2

SUMMARY

KENTUCKY RIVER BASIN

The water quality management plan for the Kentucky River Basin includes a detailed description and analysis of the many factors which impact in some way on water quality. An analysis of physiography, topography, geology, soils and hydrology is included. The plan also contains a detailed description of present and projected socio-economic conditions and present and projected water quality conditions within the basin for input to the larger state and nationwide water quality management effort. The following represents the highlights of the study, with detailed information presented in subsequent chapters.

Methodology and Findings

Prior to initiation of detailed planning, existing data were collected and evaluated to serve as a foundation for the planning process. In some cases the generation of additional data was necessary to satisfy the basic elements of River Basin Planning.

Once the hydrologic characteristics of the basin were identified, the basin was subdivided into smaller planning units called "segments", as shown on EXHIBIT 2.1m. Each segment contains similar hydrologic characteristics, i.e. stream flow, stream slope, and other physical and geographic considerations. The 59 segments within the Kentucky River Basin were evaluated with respect to existing water quality and discharge characteristics of each source of pollution. Present and projected trends for population, land use and economic factors were evaluated in terms of their effects on water quality.

Segments were then classified as being either Water Quality Limited (WQL) or Effluent Limited (EL), after evaluation of water quality information for the segment. A Water Quality Limited segment does not meet applicable water quality standards and/or is not expected to meet the standards even after the application of the effluent limitations required by section 301 of the Act. An Effluent Limited segment presently meet and will continue to meet applicable water quality standards or appears capable of meeting the standards after application of the secondary treatment. In the Kentucky River Basin there are 23 segments classified as Water Quality Limited and 36 classified as Effluent Limited (See EXHIBIT 4.2m).

In order to compare and rank segments within the basin according to the extent of pollution, a segment priority formula was developed which considers the population affected, severity of existing pollution, thermal discharges, and non-point sources of pollution (acid mine drainage, sediment runoff, combined sewers, urban runoff). The 59 segments in the Kentucky River Basin are ranked according to their priority number shown in EXHIBIT 2.2t, and the values assigned to the component parts of the priority formula are indicated. As there are no significant thermal dischargers in the basin, no column was provided for this factor.

The severity of pollution factor is based on a formula which compares the difference between the most restrictive requirement for various pollutants and the amount currently discharged by treatment facilities within the segment. For most segments with high priority numbers, the severity of pollution factor is the major component. Priority numbers for segments in the basin range from 4,950 for Segment #17 (South Elkhorn Creek), to 0.1 for Segment #29 (Dix River below Herrington Lake). Other segments which have high priority numbers include #12 with 4,600 (Kentucky River near Frankfort), #31 with 1,325 (Clark's Creek near Danville), #16 with 1,200 (North Elkhorn Creek near Georgetown), #2 with 550 (Kentucky River near Carrollton), #28 with 495 (Otter Creek near Richmond), #27 with 395 (Tate Creek near Richmond), and #48 with 390 (North Fork Kentucky River near Hazard).

The non-point source factor for the priority formula allows an allocation of up to 100 points where significant non-point sources occur. In the Kentucky River Basin this allocation was primarily due to acid mine drainage and sediment runoff from mining operations in the Headwater Section, and agricultural sediment runoff and urban runoff in the Bluegrass Section. Specific water quality data relevant to non-point sources are extremely limited and the values indicated in EXHIBIT 2.2t for non-point sources are relative. Although sediment runoff from agricultural land is a recognized problem in the basin, data are unavailable to identify the extent of runoff for individual segments. Urban runoff is a non-point source of pollution for Frankfort (Segments #12, #13, and #15), Lexington (Segments #16, #17, #18, and #25) Richmond (Segments #27 and #28) and Danville (Segment #31). Non-point sources from coal mining are identified for Segments #44 through #59 in the Headwater Section of the basin.

EXHIBIT 2.3t lists Construction Abatement Priorities and estimated wastewater treatment costs for municipalities in the Kentucky River Basin. The Construction Abatement Priority for municipal facilities is based on existing water quality in the segment where the discharge is located and the needs of the municipality. (Refer to Appendix B for component parts of the Abatement Priority for each municipality).

Lexington No.2 plant, which discharges into Town Branch, South Elkhorn Creek,has the highest Construction Abatement Priority for the Kentucky River Basin.

The relationship between Priority Numbers on EXHIBIT 2.2t and Construction Abatement Priority on EXHIBIT 2.3t should be noted. In general, the larger dischargers with the greatest needs have the larger Construction Abatement Priority numbers, and barring unusual circumstances,the information contained on the two exhibits will be used by the Division of Water for allocating funds for construction of pollution abatement facilties. Based on data currently avail-

able and shown in the plan, twenty-two municipal dischargers will require additional treatment facilities to prevent water quality violations, while nine municipal dischargers will not be required to construct additional facilities.

EXHIBIT 2.4g,entitled Summary Hydrographs,reflects relationships that have emerged as the result of extensive study of the river basin. Cost data were developed using 1975 dollars for 1980 waste treatment construction needs with consideration given to projected growth. It will be necessary to re-adjust these cost figures in light of the extreme fluctuations of dollar value. For this reason and others, such as population shifts that may occur, the cost data should be viewed in general terms. The cost curves should not be used to determine total cost or per capita cost on a project basis.

Significant relationships that are readily discernible from the hydrographs are set forth below.

(1) The Dissolved Oxygen (DO) level is influenced by changes in the elevation (slope) of the stream except in the extreme headwaters,where a significant waste load exists for the City of Whitesburg and the stream flow approaches zero during a 7-day, 10-year low flow frequency (the base flow frequency used throughout this report). Fluctuations of the DO are closely correllated to the location of navigation structures on the river. It should be pointed out that DO standards of 5 parts per million are not violated in any portion of the main stem or the North Fork of the Kentucky River.

(2) The assimilative capacity is very low in the extreme headwaters due to lack of significant flow during a 7-day, 10-year low flow frequency but increases sharply as the result of augmentation flow from Carr Fork Reservoir. Another sharp increase in assimilative capacity occurs near River Mile 260 as a result of the change in elevation (slope) of the stream. As the flow passes into the pools created by the navigation locks and dams, the assimilative capacity greatly decreases.

(3) Travel Time and Elevation (slope) are closely related in that they are inversely proportional.

(4) As would be expected, drainage area, population and flow increase as one proceeds downstream.

(5) The accumulative cost for pollution abatement facilities (1975 dollars) for the Kentucky River Basin is approximately $200 million dollars. It has been projected that the 1980 basin population will approximate 608,000. Based on these gross figures, the per capita cost will approximate $330. The cost data used in the preparation of EXHIBIT 2.4g do not include operational and maintenance costs.

Recommendations

In developing the Kentucky River Basin Plan, it became readily apparent that there were significant gaps in available data considered vital to making comprehensive water quality management decisions. Therefore, as part of the continuing water quality management process, it is recommended that field offices be established within each basin or on a shared basis to gather and analyze water quality data on a continuing basis and to render technical assistance to local communities. Field offices should be strategically located within the area to be served and should have laboratory and monitoring equipment and qualified personnel to accomplish the following:

(1) Identify water quality problem areas.

(2) Coordinate 201 and 208 planning activities.

(3) Inspect construction of wastewater facilities.

(4) Operate and maintain the monitoring and surveillance network.

(5) Operate a mobile type monitoring station for spot checking potential water quality problem areas in addition to the established monitoring network. The mobile monitoring stations could also provide the means to quickly assess the results of abatement programs on water qualtiy.

(6) Establish and operate a regional laboratory for rendering services to the smaller communities and for providing additional data to the Central Office for filling data gaps that presently exist.

(7) Provide other data and assistance to the Central Office for updating water quality management data.

(8) Assist in wastewater treatment plant operator training and certification.

(9) Review plans and specifications for wastewater treatment facilities to ascertain conformance with required treatment levels of the basin.

(10) Provide guidance and control during emergencies such as "emergency spills" and other unusual and unpredictable events that will undoubtedly occur.

(11) Coordinate water quality management planning at the basin level with other governmental and non-governmental agencies.

It is recommended that a River Basin Office be established in or near the City of Richmond, with a sub-office at Hazard. These locations were selected for the following reasons: (a) Richmond is near the major population centers of the basin, where the more severe point source pollution problems exist. Additionally, Eastern Kentucky University, located in Richmond, may provide technical assistance to the field staff. (b) A major portion of the strip mining is taking place in the headwaters of the basin. A sub-office in Hazard would permit continual supervision of water quality activities in this area of the basin.

Additional water quality monitoring stations are needed, including primary and secondary types. The minimum number recommended are 14 primary and 22 secondary locations which are outlined in Chapter V.

KENTUCKY RIVER BASIN

EXHIBIT 2.1 m

SEGMENT LOCATION

LEGEND

- 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- (16) SEGMENT NUMBER

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Miller, Wihry & Lee
INCORPORATED
Landscape Architects and Engineers
Landward House • 1387 South Fourth Street • Louisville, Kentucky

KENTUCKY RIVER BASIN

EXHIBIT 2.1 m

SEGMENT LOCATION

LEGEND

- 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- (16) SEGMENT NUMBER

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U S Geological Survey

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Exhibit 2.2t Summary Information on Segment Priority Ranking

Segment No.	River Mile Description	Location	Segment Priority				
			Population Factor	Severity of Pollution Factor	Non-Point Sources Factor	Priority Number	Rank in Basin
1	434.8-0.0	Little Kentucky River	5.2	0	0	5.2	45
2	435.6-0.0/4.0	Kentucky River from Confluence with Ohio River to Lock and Dam #1	4.5	545.5	0	550	5
3	4.0/ 10.97	Kentucky River from Lock and Dam #1 to Confluence with Eagle Creek	1.9	0	0	1.9	56
4	10.97/ 31.0	Kentucky River from Confluence with Eagle Creek to Lock and Dam #2	7.8	332.2	0	340	11
5	31.0/ 42.0	Kentucky River from Lock and Dam #2 to Lock and Dam #3	4.4	0	0	4.4	46
6	42.0/ 51.9	Kentucky River from Lock and Dam #3 to Confluence with Elkhorn Creek	2.0	0	0	2.0	55
7	10.97-0/34.6	Eagle Creek from Confluence with Kentucky River to Clark's Creek	3.5	0	0	3.5	49
8	10.97-27.4-0.0/	Ten Mile Creek from Confluence with Eagle Creek to Headwaters	2.7	0	0	2.7	54
9	10.97-34.6-0.0/	Clark's Creek from Confluence with Eagle Cr. to Headwaters	4.2	30.8	0	35	33
10	10.97-34.6	Eagle Creek from Clark's Cr. to Headwaters	6.9	76.1	0	83	24
11	10.97-38.8-0.0/	Stevens Cr. from Confluence with Eagle Cr. to Headwaters	1.9	91.1	0	93	23
12	51.9/ 65.0	Kentucky River from Confluence with Elkhorn Creek to Lock and Dam #4	22.8	4477.2	100	4600	2
13	65.0/ 82.5	Kentucky River from Lock and Dam #4 to Lock and Dam #5	17.8	142.2	25	185	15
14	82.5/ 96.2	Kentucky River from Lock and Dam #5 to Lock and Dam #6	4.8	13.2	0	18	40
15	51.9-0.0/17.8	Elkhorn Creek from Confluence with Kentucky River to the forks of Elkhorn Creek	3.7	0	25	28.7	35

Exhibit 2.2t Summary Information on Segment Priority Ranking

Segment No.	River Mile Description	Location	Segment Priority				
			Population Factor	Severity of Pollution Factor	Non-Point Sources Factor	Priority Number	Rank in Basin
16	51.9-17.8/	North Elkhorn Creek from Confluence with Elkhorn Cr. to Headwaters	27.1	1072.9	100	1200	4
17	51.9-17.8-0.0/	South Elkhorn Creek from Confluence with Elkhorn Cr. to Headwaters	120	4730	100	4950	1
18	51.9-45.3-0.0/	Cane Run from Confluence with No. Elkhorn to Headwaters	10.6	129.4	50	190	14
19	96.2/117.0	Kentucky River from Lock and Dam #6 to Lock and Dam #7	2.9	0	0	2.9	53
20	117.0/139.9	Kentucky River from Lock and Dam #7 to Lock and Dam #8	13.4	366.6	0	380	9
21	139.9/157.5	Kentucky River from Lock and Dam #8 to Lock and Dam #9	3.0	0	0	3.0	51
22	157.5/176.4	Kentucky River from Lock and Dam #9 to Lock and Dam #10	2.2	22.8	0	25	38
23	176.4/190.8	Kentucky River from Lock and Dam #10 to Confluence with Red River	8.2	119.8	0	128	20
24	190.8/201.0	Kentucky River from Confluence with Red River to Lock and Dam #11	1.0	0	0	1.0	58
25	135.3-0.0/	Hickman Creek	69.1	118.4	25	212.5	13
26	170.6-0.0/	Boone Cr. from Confluence with Kentucky River to Headwaters	1.6	65.4	0	67	25
27	158.1-0.0/	Tate Creek from Confluence with Kentucky River to Headwaters	8.8	371.2	10	390	7
28	177.3-0.0/	Otter Creek from Confluence with Kentucky River to Headwaters	13.6	456.4	25	495	6
29	118.2-0.0/3.0	Dix River from Confluence with Kentucky River to Dam	0.1	0	0	0.1	59
30	118.2-3.0/26.2	Herrington Lake	3.7	52.3	0	56	28

Exhibit 2.2t Summary Information on Segment Priority Ranking

Segment No.	River Mile Description	Location	Segment Priority				
			Population Factor	Severity of Pollution Factor	Non-Point Sources Factor	Priority Number	Rank in Basin
31	118.2-26.2/	Clark's Creek from Confluence with Dix River to Headwaters	14.2	1285.8	25	1325	3
32	118.2-26.2/51.1	Dix River from Herrington Lake to Logan Creek	9.2	160.8	0	170	16
33	118.2-51.1/	Dix River from Logan Creek to Headwaters	10.7	109.3	0	166	17
34	146.0-0.0/	Paint Lick Creek from Confluence with Kentucky River to Headwaters	6.4	373.6	0	380	10
35	150.30.0/	Silver Creek from Confluence with Kentucky River to Headwaters	10.9	149.1	0	160	18
36	201.0/220.9	Kentucky River from Lock and Dam #11 to Lock and Dam #12	16.0	0	0	16.0	42
37	220.9/239.9	Kentucky River from Lock and Dam #12 to Lock and Dam #13	4.0	0	0	4.0	48
38	239.9/249.0	Kentucky River from Lock and Dam #13 to Lock and Dam #14	3.4	0	0	3.4	50
39	249.0/254.8	Kentucky River from Lock and Dam #14 to Confluence with South Fork Kentucky River	1.7	2.3	0	4.0	47
40	190.8-0.0/21.4	Red River from Confluence with Kentucky River to Brush Creek	5.9	0	0	5.9	44
41	190.8-21.4/41.1	Red River from Confluence with Brush Creek to Middle Fork Red River	3.0	0	0	3.0	52
42	190.8-41.1/59.5	Red River from Middle Fork Red River to Swift Camp Creek	2.8	37.2	0	40	30
43	190.8-59.5/	Red River from Swift Camp Creek to Headwaters	1.9	0	0	1.9	57
44	254.8-0.0/45.1	South Fork Kentucky River	12.6	0	10	22.6	39
45	258.6-0.0/43.26	Middle Fork Kentucky River from Confluence with North Fork to Dam	4.8	0	10	14.8	43
46	258.6-43.26/60.0	Buckhorn Lake	1.8	0	15	16.8	41

Exhibit 2.2t Summary Information on Segment Priority Ranking

Segment No.	River Mile Description	Location	Segment Priority				
			Population Factor	Severity of Pollution Factor	Non-Point Sources Factor	Priority Number	Rank in Basin
47	254.8/300.1	North Fork Kentucky River from Confluence with Kentucky to Jackson STP	7.3	112.7	15	135	19
48	300.2/361.0	North Fork Kentucky River from Jackson STP to Dam at Hazard Water Plant	14.4	325.6	50	390	8
49	307.8-0.0/	Quicksand Creek from Confluence with Kentucky River to Headwaters	6.0	0	50	56	29
50	313.7-0.0/	Troublesome Cr. from Confluence with Kentucky River to Headwaters	10.3	36.7	50	97	22
51	254.8-45.1-0.0/	Goose Creek form Confluence with South Fork Kentucky River to Headwaters	17.2	163.8	50	231	12
52	254.8-45.1/	Redbird River from Confluence with South Fork to Headwaters	8.7	0	25	33.7	34
53	258.6-60.0/73.5	Middle Fork Kentucky River from Buckhorn Lake to Bull Cr.	3.0	0	25	28	36
54	258.6-73.5/	Middle Fork Kentucky River from Bull Creek to Headwaters	6.8	72.1	35	113.9	21
55	361.0/388.0	North Fork Kentucky River from Hazard Water Plant to Rockhouse Creek	10.3	0	50	60.3	27
56	367.8-0.0/8.78	Carr Fork from Confluence with North Fork Kentucky River to Dam	1.6	0	35	36.6	31
57	367.8-8.78/16.35	Carr Fork Lake	0.9	0	25	25.9	37
58	367.8-16.35/	Carr Fork Cr. from Confluence with Carr Fork Lake to Headwaters	1.3	0	35	36.3	32
59	388.0/	North Fork Kentucky River from Rockhouse Creek to Headwaters	12.6	0	50	62.6	26

Exhibit 2.3t Construction Abatement Priorities

Municipality	Disc. Code No.	Kentucky River Seg. No.	Const. Abatement Priority	Total Needs-1995 Million $
Lexington #2	04016	017	7781 Aa	62. 2
Frankfort	04023	012	5779 Ba	24. 8
Georgetown	04010	016	2112 Ca	3.55
Danville	04032	031	2109 Ba	4. 9
Richmond #1	04049	028	1160 Ba	7.28
New Castle	04006	004	885 Ca	0. 6
Richmond #2	04046	027	672 Ba	2.42
Carrollton	04001	002	671 Ca	3.75
Manchester	04065	051	668 Ca	0. 7
Berea #2	04043	034	662 Ca	1.88
Hazard	04059	048	510 Ca	0.25
Nicholasville	04038	020	458 Ca	3. 8
Berea #1	04045	035	398 Ca	5.17
Lancaster	04036	032	392 Ca	1.92
Hindman	04058	050	288 Ca	0.95
Owenton	04004	011	261 Ca	0.63
Versailles	04025	013	240 Ca	5. 7
Lexington #1	04041	025	235 Aa	33. 8
Stanford	04037	033	200 Ca	1.25
Midway	04015	017	196 Ca	1. 0
Wilmore	04039	020	168 Ca	5.73
Jackson	04057	047	159 Ca	0. 2
Corinth	*	010	123 Ca	0.95
Brodhead	04067	033	121 Ca	0.93
Campton	04054	042	87 Ca	0.35
Stamping Ground	*	010	84 Cc	1.05
Whitesburg **	04061	059	81 Ca	7.76**
Sadieville	*	016	63 Ca	0.65
Hyden	04062	054	60 Ca	1.07
Williamstown	04003	009	44 Ca	2. 2
Crab Orchard	*	033	41 Ca	1.85
Hustonville	*	033	39 Ca	1.55
New Liberty	*	004	28 Ca	0. 5
Irvine-Ravenna	04055	036	20 Ca	6.75
Booneville	04064	044	19 Ca	0.32
Dry Ridge	*	009	12 Ca	1. 9
Beattyville	04056	039	10 Ca	0.44
Clay City	04051	040	8 Ca	0.45
Crittenden	*	008	7 Ca	0.65
Monterey	*	005	6 Ca	0.45
Hazel Green	*	043	4 Ca	1.13
Stanton	04052	041	4 Ca	3. 2
Sparta-Sanders	*	007	4 Ca	1.05
Vicco	04060	056	0 Ca	0

* This municipality has no existing and/or no collection facilities but a 201 Facilities Plan has been designated.

** Includes entire Letcher County Service Area.

As part of the recommended monitoring effort, data gathering should be initiated for determining the magnitude of phosphorus being discharged to the major reservoirs of the basin.

Impacts upon water quality resulting from strip mining in the Headwater Regions of the Basin include high storm water runoff rates from logging operations which often precede strip mining activity, erosion and siltation resulting from the actual mining activity, and sedimentation problems related to coal haul roads.

Kentucky has enacted strip mine legislation which is considered by many to be a model law. However, implementation of this legislation and enforcement of accompanying regulatory measures have been extremely uneven, resulting in water quality degradation in a number of areas within the Kentucky River Basin. Therefore, if water quality objectives for the Kentucky River Basin are to be achieved, strip mine regulations must be strictly and equitably enforced.

Solids processed and removed by wastewater treatment plants are difficult to dispose of because there is no clear state policy on their acceptability in licensed sanitary landfills. It is therefore recommended that the Division of Water Quality and Division of Solid Waste explore the potential of utilizing processed sludge, a significant resource, for application on agricultural lands in the basin.

Accurate and detailed cost data on wastewater facilities for each municipality,along with alternative treatment methods are needed by the Division of Water in order to properly allocate available resources, and to provide information for future updating of this plan. It is recommended that 201 Facilities Plans be completed as soon as possible to provide the comprehensive data needed to assist the Division in carrying out a comprehensive water quality management program.

Kentucky communities have available adequate legislative authority to manage and guide growth and development and, in turn, protect water quality in accordance with sound environmental principles. However, few communities have implemented innovative measures for guiding growth and development on the one hand while maintaining the integrity of the environment on the other. Few community comprehensive plans are based on environmental inventories and suitability analyses, and few communities have made a concerted effort to coordinate the need for developing additional acreage for urban uses with the community's ability to provide basic urban services such as sewers and waste treatment facilities.

To protect land and water resources in urbanizing areas of the Kentucky River Basin, more land capability planning will be necessary to guide growth in areas best suited for development. Ordinances will need to be adopted to minimize non-point source pollutants resulting from construction activity as undeveloped land is given over to urban uses, and innovative approaches sought to minimize the impact of urban area storm water runoff on water quality.

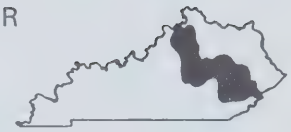
In addition, mechanisms should be established to provide a continuing update on socio-economic and land use information as it relates to water quality management. Further research and improvement in socioeconomic and land use projection techniques are of vital importance in developing a truly comprehensive water quality management strategy and process. And finally, approaches should be sought to coordinate the many federal, state and local projects and programs which in some way impact upon water quality, for only through an integrated system of decision-making can truly comprehensive water quality management be effected.

The planning for and construction of wastewater facilities is beyond the financial capability of many of the smaller cities in the Commonwealth. Without additional financial assistance above and beyond that provided by the EPA,the smaller communities will not be able to comply with the requirements of Public Law 92-500. Therefore, it is recommended that the Department for Natural Resources and Environmental Protection in concert with the Legislative Branch prepare proposed legislation for submission to the 1976 General Assembly to provide state grants-in-aid to communities that are unable to provide the twenty-five percent matching funds presently required under the Act.

CHAPTER 3

BACKGROUND

KENTUCKY RIVER BASIN



INTRODUCTION

In order to develop a comprehensive water quality management strategy for the Commonwealth, an understanding of the natural and man-made environment and processes and the interrelationship of the various elements of each is essential. An understanding of physiography, geology, hydrology, population, employment and land use is necessary, for each produces unique impacts on water quality.

Therefore, this chapter contains background environmental, socio-economic and water quality information which will serve as the foundation for development of the comprehensive water quality management strategy for the Kentucky River Basin. Environmental features of the Kentucky River Basin are discussed first in the section entitled "Physiography", followed by population, housing, employment and land use information. Finally, the chapter contains background information on commonly used wastewater control methods, information on existing water quality, and applicable water quality standards. More detailed tabular data in many of these areas are presented in Appendix A.

PHYSIOGRAPHY

Terrain features of a geographic region are an expression of weathering processes and time on the geologic formations of the area. Physiographic regions have similar topographic features due primarily to their similar geologic formations. After a brief description of the basin and discussion of physiographic regions within the Kentucky River Basin, a more detailed discussion will be made of the topographic and geologic features which influence water quality management. Major soil associations within the basin will then be presented with interpretations of their suitability for septic tank drain fields, land application of treated wastewater, and erosion potential. Surface groundwater hydrology in the basin will be discussed in the final part of this section.

The Kentucky River Basin lies entirely within the Commonwealth of Kentucky and drains either wholly or partially 39 of the 120 counties in the State. The Pine Mountain ridge line in southeastern Kentucky near the Virginia border forms the top of the watershed. Three principal tributaries - North, Middle and South Forks - join to form the main stem, which flows in a northwesterly direction through the central part of the state and empties into the Ohio River at mile point 435.6 in North Central Kentucky. The total area of the basin, which is 7,079 square miles, contains the following eight sub-basins with areas of over two hundred square miles:

Kentucky River Sub-Basins	Square Miles
North Fork Kentucky River	1,883.0
South Fork Kentucky River	748.0
Middle Fork Kentucky River	559.0
Red River	487.0
Dix River	442.0
Elkhorn Creek	500.0
Station Camp Creek	217.0
Eagle Creek	509.2

Physiographic Regions

The Kentucky River Basin includes portions of three physiographic regions: Bluegrass, Knobs, and Mountain and Eastern Coal Field. As shown in EXHIBIT 3.1m, the northern half of the basin is within the Bluegrass Region, a narrow band traversing the center of the basin is in the Knobs Region, and the southern portion of the basin is within the Mountain and Eastern Coal Field Region. The Bluegrass Region consists of the Inner Bluegrass, Hills of the Bluegrass, and Outer Bluegrass physiographic subdivisions. The Mountain and Eastern Coal Field is comprised of the Escarpment Area, Plateau Area, and Mountain and Creek Bottom Area subdivisions (2).

Bluegrass Region - The central part of the Bluegrass Region known as the Inner Bluegrass is a gently rolling upland, or peneplain, underlain by thick-bedded, highgrade limestone in which the Kentucky River and some of its tributaries are entrenched more than 350 feet. The Inner Bluegrass is centered around the Lexington area and includes within the basin the cities of Frankfort, Georgetown, Nicholasville, Danville and Versailles. Major tributaries with watersheds in the Inner Bluegrass include the North and South Forks of Elkhorn Creek, Clear Creek, Hickman Creek, and Boone Creek.

The dominant rock of the Inner Bluegrass is limestone that has been subject to considerable erosion by solution, both on and beneath the surface. As a result, much of the drainage is underground. The karst topography is dotted with sinkholes, some as large as 60 feet deep and 1 square mile in area.

The Inner Bluegrass is surrounded by a band of dissected, hilly country known as the Hills of the Bluegrass or Eden Shale Belt. The Hills of the Bluegrass is underlain by calcareous shale, siltstone and thin-bedded limestone. The terrain is characterized by sharp irregular ridges and narrow valleys. Because of the steep slopes and impermeable shale bedrock, runoff is rapid and few perennial streams originate in the Hills of the Bluegrass.

Most of the northern part of the Kentucky River Basin and a narrow band paralleling the river through the central part of the basin are in the Hills of the Bluegrass physiograhic area. Major tributaries in the northern part include Eagle Creek, Cedar Creek and the lower reaches of Drennon Creek. Through the central part of the basin, the lower reaches of Tate

Creek, Silver Creek, Paint Lick Creek, and Sugar Creek are in the Hills of the Bluegrass.

The Outer Bluegrass physiographic area surrounds the Hills of the Bluegrass. The gently rolling terrain of the Outer Bluegrass is generally underlain by thin-bedded limestone formations that include considerable inter-bedded shale. The topography resembles that of the Inner Bluegrass except near streams, where it is dissected and rugged. There has been some surface solution, and small sinkholes are fairly common, but most of the drainage is on the surface.

The upper reaches of the Little Kentucky River and Drennon Creek, a tributary of the Kentucky River near New Castle and Eminence, are in the Outer Bluegrass area. In the southern part of the Bluegrass Region, an area about 10 miles wide through Clark, Madison, Garrard and Lincoln Counties is in the Outer Bluegrass. Major tributaries include Upper Howard Creek, Muddy Creek, and the upper reaches of Otter Creek, Silver Creek, Paint Lick Creek, and Dix River.

Knobs Region - This region is named for its conical and flat-topped hills called knobs. The Knobs Region forms a narrow crescent separating the Bluegrass from the Mountain and Eastern Coal Field. The Knobs are erosional remnants of the adjoining Eastern Coal Field Region which have sandy limestone and sandstone caprock over less resistant, thin-bedded shales and limestone formations characteristic of the Outer Bluegrass. Towards the Hills of the Bluegrass the terrain is flat and rolling with scattered knobs and wide valleys, while the outer margin of the Knobs Region is more rugged.

In the Kentucky River Basin the Knobs Region includes the cities of Irvine, Stanton, and Berea. Major tributaries include the lower reaches of Red River, Station Camp Creek, and Red Lick Creek.

Mountains and Eastern Coal Field Region - The headwaters of the Kentucky River originate in the Mountains and Eastern Coal Field Region. This area is along the western edge of the Appalachian Plateau and is referred to as the Cumberland Plateau. The mountainous areas have been heavily mined for coal, and the production of natural gas is also important. The region is subdivided into three areas for ease of discussion: Escarpment Area, Plateau Area, and Mountain and Creek Bottom Area.

The Pottsville escarpment rises boldly above the Bluegrass and Knobs Regions because of sandstone and conglomerate formations that are massive and particularly resistant to erosion. Deep narrow valleys have been carved by the tributaries of the Kentucky River flowing from the Plateau area to the lower elevations of the Bluegrass. Tributaries include Red River, Sinking Creek and Sturgeon Creek. This outer Escarpment Area with cliff-sided valleys and narrow ridges is more rugged than much of the interior of the Eastern Coal Field Region. Nearly all of the Escarpment Area in the Kentucky River Basin is within the Daniel Boone National Forest (formerly the Cumberland National Forest).

The Plateau Area is the least rugged of the three areas. Much of the land is undulating to rolling where plateau levels still exist. The area is underlain by sandstones, siltstones, shale and coal. Limestone formations are exposed in some of the valleys of major tributaries. The three main forks of the Kentucky River -- North Fork, Middle Fork, and South Fork -- join within a few miles of each other near the City of Beattyville.

The Mountain and Creek Bottom Area includes the headwaters of the Kentucky River. Its rugged terrain is deservedly called mountainous. Ridges are high and sharp-crested; there is little level upland, and valleys are narrow. The ridges extend in a northeast-southwest direction, and the mountains are generally more rugged toward the southwest corner of the basin. The area is best known for its coal resource. Cities along the North, Middle and South Forks Kentucky River include Hazard, Jackson, Hyden, and Manchester.

Topography

For purposes of discussion, the Kentucky River Basin will be divided into a "Headwater Section", beginning at the headwaters and ending at the City of Irvine, and a "Bluegrass Section", comprising the remainder of the basin. The Headwater Section covers over 2,900 square miles of drainage area in the Mountains and Eastern Coal Field physiographic region and includes the three principal tributaries which form the Kentucky River and 37 miles of the main stem between their juncture and the City of Irvine. The Bluegrass Section of the Kentucky River Basin includes a drainage area of over 4,000 square miles. The river is deeply entrenched in meandering loops as it progresses northwestward through the heart of the Bluegrass Region.

The highest and lowest elevations in the Kentucky River Basin are 3273 feet mean sea level (msl) on Pine Mountain in the southeast corner of the basin and 420 feet msl normal pool elevation where the Kentucky River enters the Ohio River. Elevations along the Pine Mountain thrust fault at the top of the watershed range from about 2000 feet msl in the southwest corner of the basin to 3273 feet msl in the southeast corner.

Mountain-top elevations throughout the Headwater Section generally range from 1000 feet to 1600 feet msl. In the Escarpment Area east of Irvine, ridgetops are generally 1200 to 1400 feet msl; in the Plateau Area around Beattyville, they are about 900 to 1100 feet msl. In the Mountain and Creek Bottom Area toward the top of the Headwater Section, the ridgetops are about 1400 to 1600 feet msl except near the Pine Mountain, where they are 1800 to 2000 feet msl.

Sideslopes on the mountains are generally steep and vary from vertical cliffs in the Escarpment Area to 20 to 60 percent slopes in the Plateau Area. In terms of water quality management, stream slope is of primary interest, since this determines the natural reaeration rate of the stream. It therefore influences the waste load assimilation capacity of the stream. In the Headwater Section, the average slope of the North, Middle and South Forks of the Kentucky River is about 3 ft./mi., as shown in EXHIBIT 3.2t. Over the 148-mile length of the North Fork, stream slopes range from 13.0 ft./mi. toward the top of the watershed to 0 ft./mi. where it joins with the Middle Fork; the average slope over the entire length is 3.2 ft./mi. These slopes are moderate; therefore, the waste load assimilation rate is moderate.

SIOGRAPHIC REGIONS

Drainage		Geology		General Groundwater Quality*		
Off	Internal	Formation	Type	Hardness (ppm)	Chloride (ppm)	Sulphate (ppm)
n	Medium	mO	ls, sh	250-600	2-75	0.4-100
Rap.	Slow	uO	ls, sh	250-600	2-75	150+
Rap.	Medium	uO	ls, sh	250-600	2-75	0.4-100
Rap.	Very Slow	S & D	sh, ls	250-600	2-75	0.4-100
	Slow	S & D	sh, ls			
Rap.	Medium	M	ls	125-225	0-10	10-25
Rap.	Med.-Slow	P	sa, sh	25-150	50-150	0.2-380
	Medium	P	sa, sh	25-150	50-150	0.2-380

Interface Map of Kentucky. Kentucky Geological Survey

KENTUCKY RIVER BASIN

EXHIBIT 3.1m

PHYSIOGRAPHIC REGIONS

LEGEND

- 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- PHYSIOGRAPHIC REGION BOUNDARY
- PHYSIOGRAPHIC SUBDIVISION BOUNDARY

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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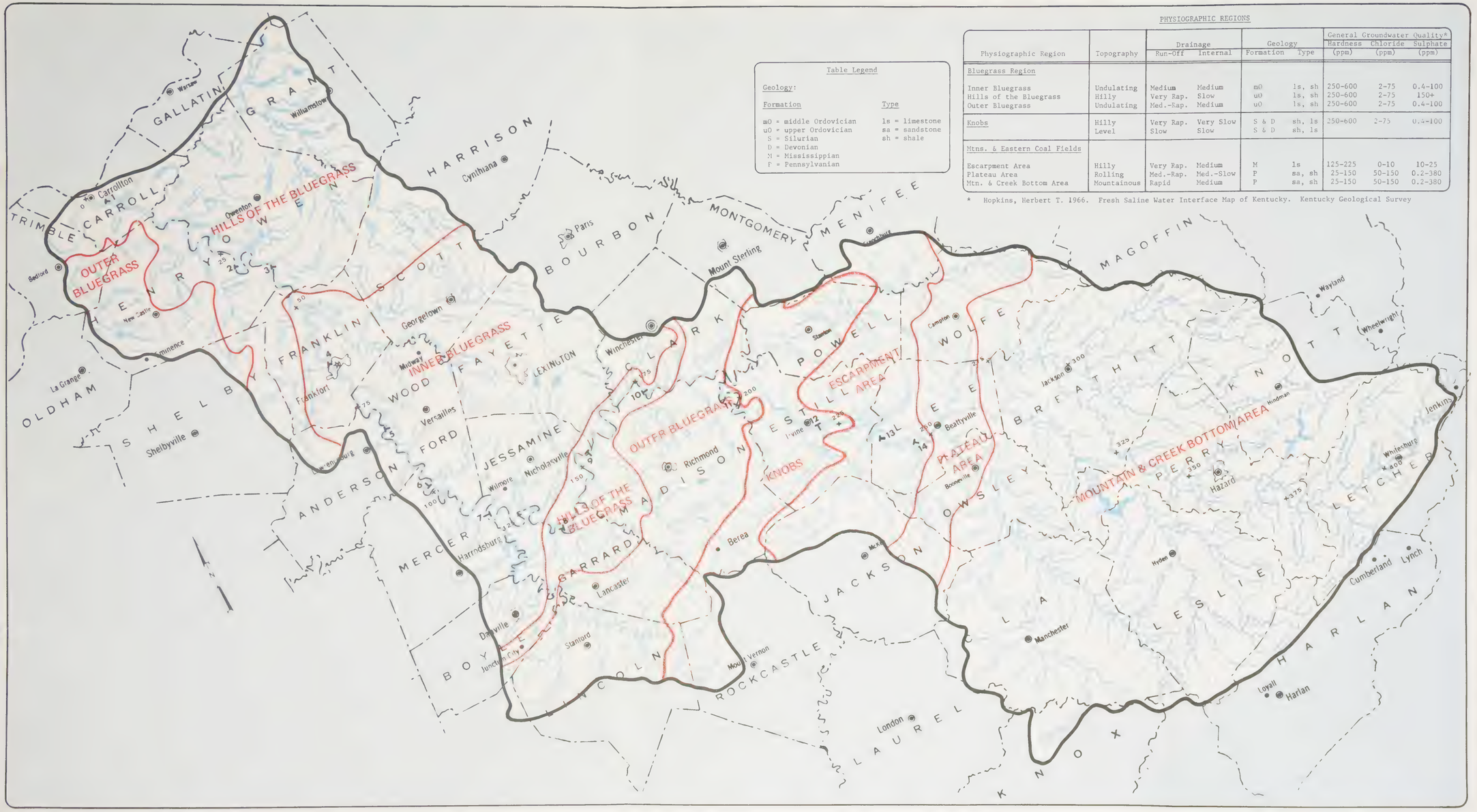

Table Legend

Geology:

Formation	Type
mO = middle Ordovician	ls = limestone
uO = upper Ordovician	sa = sandstone
S = Silurian	sh = shale
D = Devonian	
M = Mississippian	
P = Pennsylvanian	

PHYSIOGRAPHIC REGIONS

Physiographic Region	Topography	Drainage		Geology		General Groundwater Quality*		
		Run-Off	Internal	Formation	Type	Hardness (ppm)	Chloride (ppm)	Sulphate (ppm)
Bluegrass Region								
Inner Bluegrass	Undulating	Medium	Medium	mO	ls, sh	250-600	2-75	0.4-100
Hills of the Bluegrass	Hilly	Very Rap.	Slow	uO	ls, sh	250-600	2-75	150+
Outer Bluegrass	Undulating	Med.-Rap.	Medium	uO	ls, sh	250-600	2-75	0.4-100
Knobs	Hilly Level	Very Rap. Slow	Very Slow Slow	S & D S & D	sh, ls sh, ls	250-600	2-75	0.4-100
Mtns. & Eastern Coal Fields								
Escarpment Area	Hilly	Very Rap.	Medium	M	ls	125-225	0-10	10-25
Plateau Area	Rolling	Med.-Rap.	Med.-Slow	P	sa, sh	25-150	50-150	0.2-380
Mtn. & Creek Bottom Area	Mountainous	Rapid	Medium	P	sa, sh	25-150	50-150	0.2-380

* Hopkins, Herbert T. 1966. Fresh Saline Water Interface Map of Kentucky. Kentucky Geological Survey

KENTUCKY RIVER BASIN

EXHIBIT 3.1m

PHYSIOGRAPHIC REGIONS

LEGEND

- 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- PHYSIOGRAPHIC REGION BOUNDARY
- PHYSIOGRAPHIC SUBDIVISION BOUNDARY

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U S Geological Survey

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Exhibit 3.2t Slopes and Elevations of Principal Tributaries in the Kentucky River Basin

Stream	Length (Miles)	Maximum Elevation (m.s.l.)	Minimum Elevation (m.s.l.)	Average Slope (Ft./Mi.)	Slope Range	
					Maximum (Ft./Mi.)	Minimum (Ft./Mi.)
North Fork Kentucky River	148.1	1,109	634	3.2	13.0	0
Middle Fork Kentucky River	43.3	757	634	3.0	7.5	0
South Fork Kentucky River	45.1	753	634	2.6	5.7	0
Redbird River	39.9	1,250	754	12.5	64.6	4.2
Goose Creek	21.8	830	754	3.5	4.6	2.7
Troublesome Creek	42.4	1,004	720	6.7	12.5	0
Red River	59.5	713	566	2.5	6.2	0
Otter Creek	13.1	880	566	24.0	36.8	8.8
Boone Creek	7.2	780	549	32.1	42.8	19.0
Tate Creek	12.0	870	549	26.8	46.1	17.6
Silver Creek	39.2	936	531	10.3	27.9	4.5
Paint Lick Creek	32.0	920	531	12.2	22.2	5.0
Hickman Creek	31.5	910	514	12.6	23.5	5.8
Jessamine Creek	13.1	860	519	26.0	36.3	16.2
Clarks Run Creek	10.4	920	750	16.4	33.3	7.8
Dix River						
H.W. to Mile Point 34.6	23.2	822	750	3.3	7.1	2.2
Mile Point 34.6 to 2.3 (Dam)	32.3	750	750	0	0	0
Mile Point 2.3 to Source	2.3	514	514	0	0	0
Glenns Creek	12.5	830	469	28.9	50.0	20.0
Elkhorn Creek	90.6	950	454	5.5	28.6	0
South Elkhorn Creek	51.0	950	642	6.0	20.0	1.8
Drennon Creek	16.6	800	428	22.4	50.0	1.5
Eagle Creek	81.4	737	428	3.8	5.8	1.0
Stephens Creek	20.9	920	598	15.4	50.0	5.2
Clarks Creek	15.4	791	586	13.3	45.0	8.0
Little Eagle Creek	12.6	914	737	14.0	42.5	8.0

It is interesting to note that Redbird River, considered part of the South Fork in this report, has an average slope of 12.5 ft./mi. and a range of 64.6 ft./mi. in the rugged mountainous area toward its headwaters to 4.2 ft./mi. where it joins with Goose Creek to form the South Fork. Goose Creek below Manchester has an average slope of 3.5 ft./mi., and the South Fork has an average slope of 2.6 ft./mi.

The maximum elevations of tributaties in the Headwater Section range from 760 to 1250 feet msl. Since water will hold about 2 percent less dissolved oxygen for every 500 feet in elevation above sea level, the dissolved oxygen capacity of these streams is retarded by approximately 4 percent.

Between Beattyville and Irvine the average slope on the main stem of the Kentucky River is about 0.7 ft./mi., or essentially flat, because of the lock and dam system for navigation. This relatively flat slope has a significant impact on the natural reaeration.

Topographically, the Bluegrass Section is a gently rolling and undulating peneplain with surface elevations generally between 800 and 1000 feet msl. The Kentucky River is deeply entrenched through the Bluegrass Section, with normal pool elevations ranging between 420 feet msl at Carrollton and 580 feet msl at Irvine. Therefore, the steepest slopes of most tributaries in the Bluegrass are where the streams drop down to the Kentucky River from the upland areas.

The average slope for tributaries in the Bluegrass Section ranges from 2.5 ft./mi. for the lower reaches of Red River to 32.1 ft./mi. for Boone Creek. (See EXHIBIT 3.2t) These slopes would be considered moderate to high; therefore, the waste load assimilation capacity of the tributaries in this section is moderate to high. The average slope on the main stem in this section is nearly level, or approximately 0.7 ft./mi. through the lock and dam system.

Maximum elevation of tributaries in the Bluegrass Section ranges from about 710 feet to 950 feet msl; hence, the dissolved oxygen capacity of these streams is retarded by approximately 3 percent.

Elkhorn Creek is a good example of a stream with its steepest gradient near the confluence with the Kentucky River. The average slope over its 90-mile length is 5.5 ft./mi., and the range in slope is from 28.6 to 0 ft./mi. However, the average slope is 4.4 ft./mi. for about 75 miles as it crosses the gently rolling terrain of the Inner Bluegrass region in Fayette and Scott Counties, and then the average slope below mile 16 near Frankfort is 10.3 ft./mi. as it drops from elevation 620 msl to the Kentucky River (Pool El. 454 feet msl). The minimum slope of 0 ft./mi. occurs in several flat areas as it crosses the upland, while the minimum slope in the lower 16 miles is 6.2 ft./mi. The reaeration rate would be considered moderate for the average slope of 4.4 ft./mi. on upland areas and high for the steeper gradient in the lower 16 miles of Elkhorn Creek.

In terms of water quality management, the most striking contrast between the Headwater Section and the Bluegrass Section is in the relationship between stream slope and the location of urban areas. In the more rugged mountainous terrain of the Headwater Section, towns are normally located in the wider valleys toward the bottom of the watershed where stream gradients are flatter. The best reaeration conditions toward the top of the watershed where stream slopes and upland slopes are steepest, but suitable land for development is at a minimum here.

The reverse is the case for the Bluegrass Section; the steepest stream slopes are near the confluence with the Kentucky River. Towns are generally located on the gently rolling upland area, so dischargers are upstream of the stream segment with best aeration conditions. This relationship is beneficial in improving water quality through some natural reaeration of water in tributaries before entering the main stem.

Geology

In the Headwater Section by far the most significant geological feature, in terms of water quality management, is coal. More than one-half of the drainage area of the North Fork Kentucky River lies in Letcher, Perry, and Breathitt Counties, the largest coal-producing area in Eastern Kentucky. Coal is of Pennsylvanian Age (about 240 million years old) and coal beds are from 0 to 48 inches in thickness; locally,beds up to 120 inches are reported (37). Tributaries of the Kentucky in the immediate coal mining areas are usually unsuitable for domestic or industrial use because they may be acid and contain undesirable concentrations of suspended solids and dissolved solids, particularly sulfates. Coal washing operations may cause some streams to carry high concentrations of sediment that must be eliminated to make water suitable for domestic and most industrial uses. Downstream from Hazard, pollution in the North Fork is less because unpolluted streams flow into it. However, it still has a higher concentration of dissolved solids and sulfate than the Middle or South Forks of the Kentucky River.

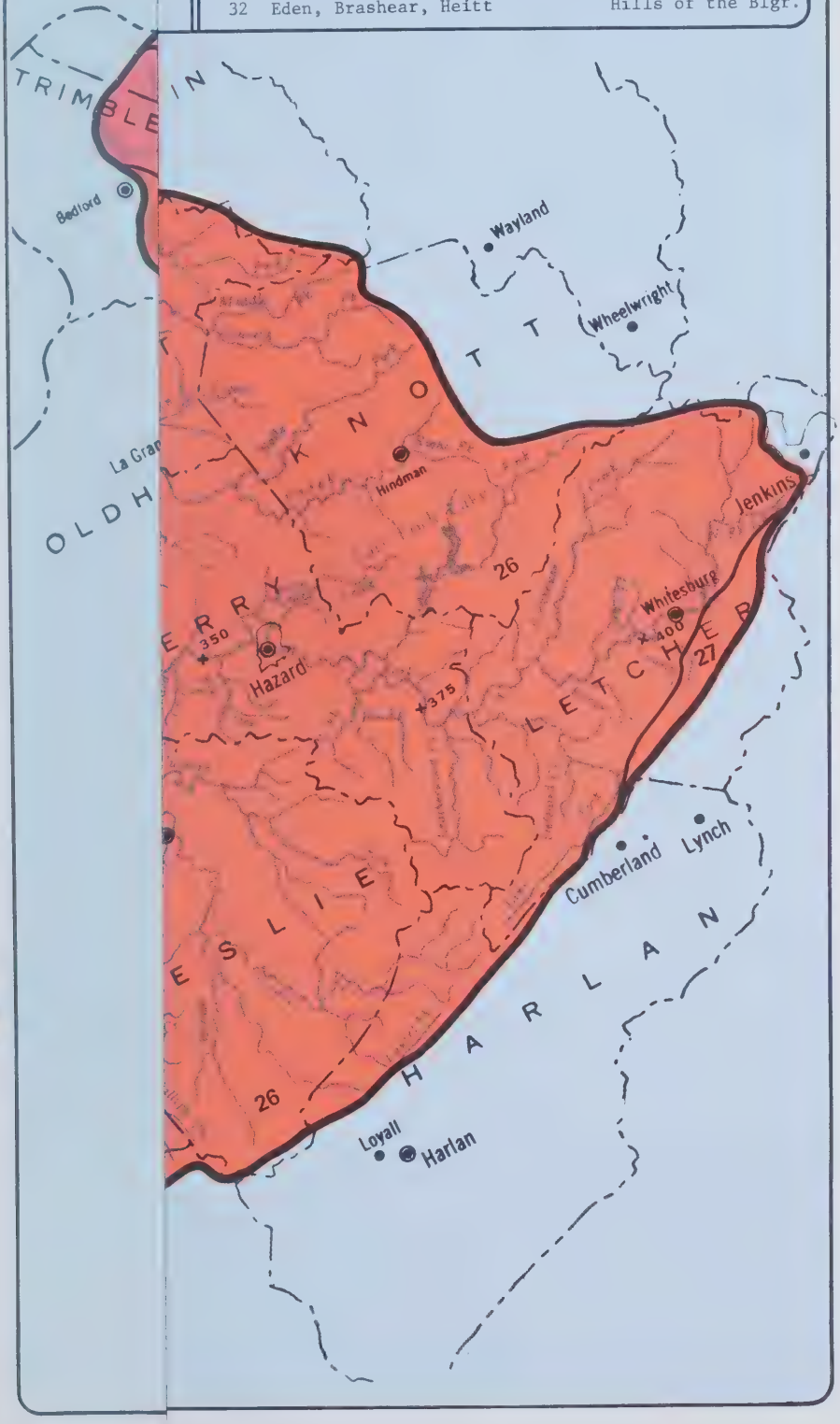
Drainage from operating and abandoned coal mines may be highly acid due to solution of sulfate from materials exposed during mining operations. Acid drainage water is highly corrosive and can kill aquatic life, as well as cause damage to water-treatment facilities, to concrete and metal culverts, and to bridges and other highway installations. Acid water causes an increase in the hardness of water by dissolving calcium and magnesium carbonate rocks.

The dominant geologic formation in the Headwater Section is the Breathitt Formation of Middle Pennsylvanian Age. It consists of variable sequences of shale sandstone, and coal with thin lenses of limestone generally not more than 2 feet thick. The thickness of the Breathitt Formation ranges from about 1000 feet in the northeastern part of the Headwater Section, to about 2200 feet in the southwestern part (37).

Where the tributaries of the Kentucky River are entrenched in steep narrow valleys, particularly in the Escarpment Area along the western margin of the Eastern Coal Field, rock formations of Mississippian Age (about 260 million year old (26)) are exposed.

The cliff-forming formations in the Pottsville Escarpment on the western edge of the Coal Field are conglomeratic sandstones and limestones of the Pennsylvanian Lee Formation, and Mississippian Newman and St. Louis formations. The Knobs to the northwest of

Map No.	Soil Association	Physiographic Region
17	Jefferson, Brookside	Escarpment area
18	Shelocta, Wharton, Jefferson	Escarpment area
19	Ashton, Huntington	Inner Bluegrass
20	Huntington, Newark, Morehead	Knobs
21	Morehead, Newark, Monongahela	Knobs
22	Shelocta, Brookside, Lathan	Escarpment area
23	Shelocta, Jefferson, Dekalb	Escarpment area
24	Shelocta, Lathan, Jefferson	Escarpment area
25	Lathan, Shelocta, Gilpin	Plateau area
26	Shelocta, Jefferson, Weikert	Mtn. & Coal Flds.
27	Shelocta, Rock Outcrop	Mtn. & Coal Flds.
28	Wheeling, Huntington	Outer Bluegrass
29	Fairmount, Lowell	Outer Bluegrass
30	Captina, Licking, Nolin	Hills of the Blgr.
31	Nicholson, Faywood	Hills of the Blgr.
32	Eden, Brashear, Heitt	Hills of the Blgr.



KENTUCKY RIVER BASIN

EXHIBIT 3.4m

SOIL INTERPRETATION

FOR SEPTIC TANK DRAIN FIELDS

LEGEND

- ⊢ 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- 20 SOIL ASSOCIATION NUMBER

SUITABILITY FOR SEPTIC TANK ABSORPTION FIELDS (2-6% Slopes)

- SLIGHT LIMITATION
- MODERATE LIMITATION
- SEVERE LIMITATION

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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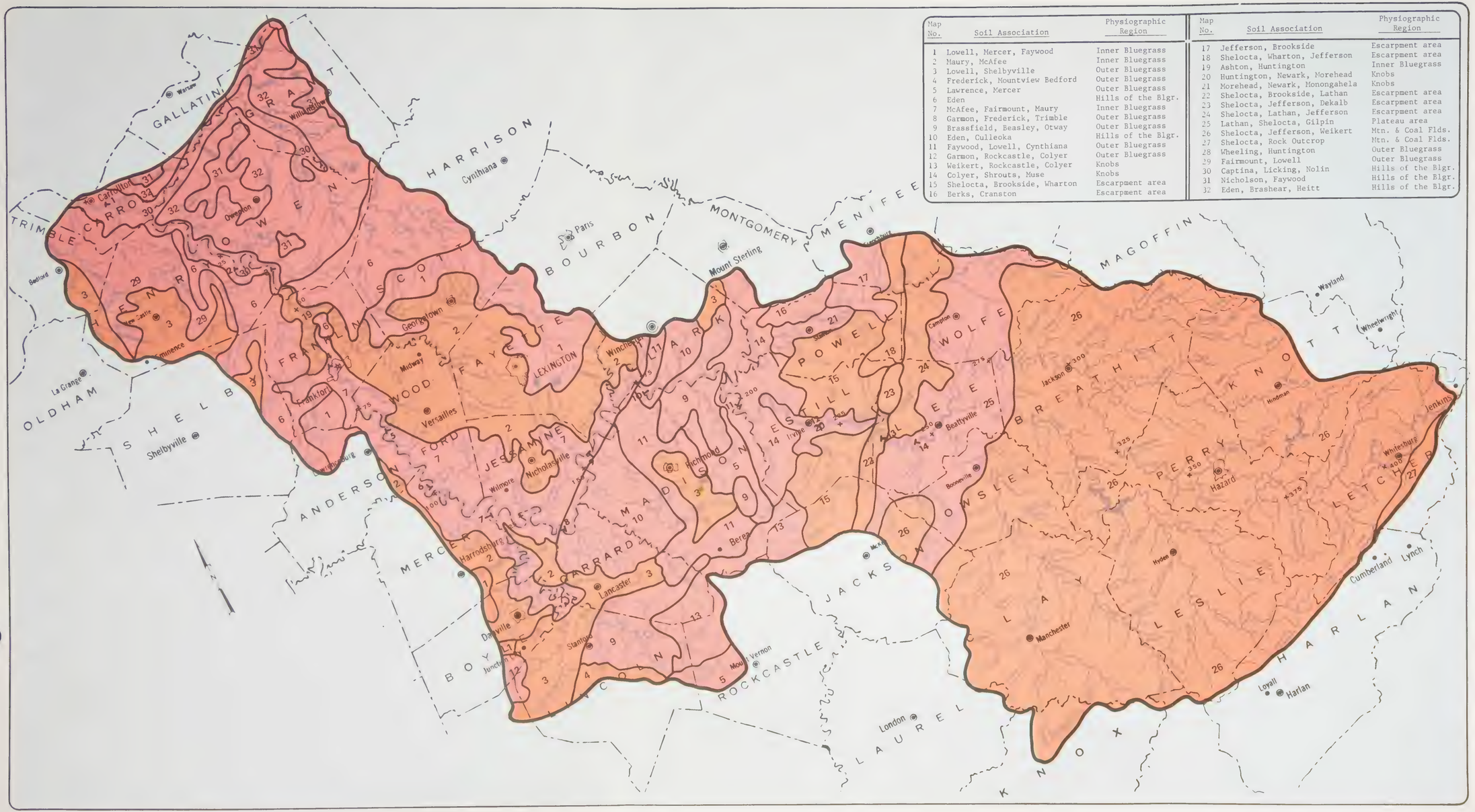

Map No.	Soil Association	Physiographic Region
1	Lowell, Mercer, Faywood	Inner Bluegrass
2	Maury, McAfee	Inner Bluegrass
3	Lowell, Shelbyville	Outer Bluegrass
4	Frederick, Mountview Bedford	Outer Bluegrass
5	Lawrence, Mercer	Outer Bluegrass
6	Eden	Hills of the Blgr.
7	McAfee, Fairmount, Maury	Inner Bluegrass
8	Garmon, Frederick, Trimble	Outer Bluegrass
9	Brassfield, Beasley, Otway	Outer Bluegrass
10	Eden, Culleoka	Hills of the Blgr.
11	Faywood, Lowell, Cynthiana	Outer Bluegrass
12	Garmon, Rockcastle, Colyer	Outer Bluegrass
13	Weikert, Rockcastle, Colyer	Knobs
14	Colyer, Shrouts, Muse	Knobs
15	Shelocta, Brookside, Wharton	Escarpment area
16	Berks, Cranston	Escarpment area
17	Jefferson, Brookside	Escarpment area
18	Shelocta, Wharton, Jefferson	Escarpment area
19	Ashton, Huntington	Inner Bluegrass
20	Huntington, Newark, Morehead	Knobs
21	Morehead, Newark, Monongahela	Knobs
22	Shelocta, Brookside, Lathan	Escarpment area
23	Shelocta, Jefferson, Dekalb	Escarpment area
24	Shelocta, Lathan, Jefferson	Escarpment area
25	Lathan, Shelocta, Gilpin	Plateau area
26	Shelocta, Jefferson, Weikert	Mtn. & Coal Flds.
27	Shelocta, Rock Outcrop	Mtn. & Coal Flds.
28	Wheeling, Huntington	Outer Bluegrass
29	Fairmount, Lowell	Outer Bluegrass
30	Captina, Licking, Nolin	Hills of the Blgr.
31	Nicholson, Faywood	Hills of the Blgr.
32	Eden, Brashear, Heitt	Hills of the Blgr.

KENTUCKY RIVER BASIN

EXHIBIT 3.4m

SOIL INTERPRETATION

FOR SEPTIC TANK DRAIN FIELDS

LEGEND

- 5 LOCK AND DAM NUMBER
- 50 RIVER MILE
- 20 SOIL ASSOCIATION NUMBER

SUITABILITY FOR SEPTIC TANK ABSORPTION FIELDS (2-6% Slopes)

- SLIGHT LIMITATION
- MODERATE LIMITATION
- SEVERE LIMITATION

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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Map No.	Soil Association	Physiographic Region
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21	Morehead, Newark, Monongahela	Knobs
22	Shelocta, Brookside, Lathan	Escarpment area
23	Shelocta, Jefferson, Dekalb	Escarpment area
24	Shelocta, Lathan, Jefferson	Escarpment area
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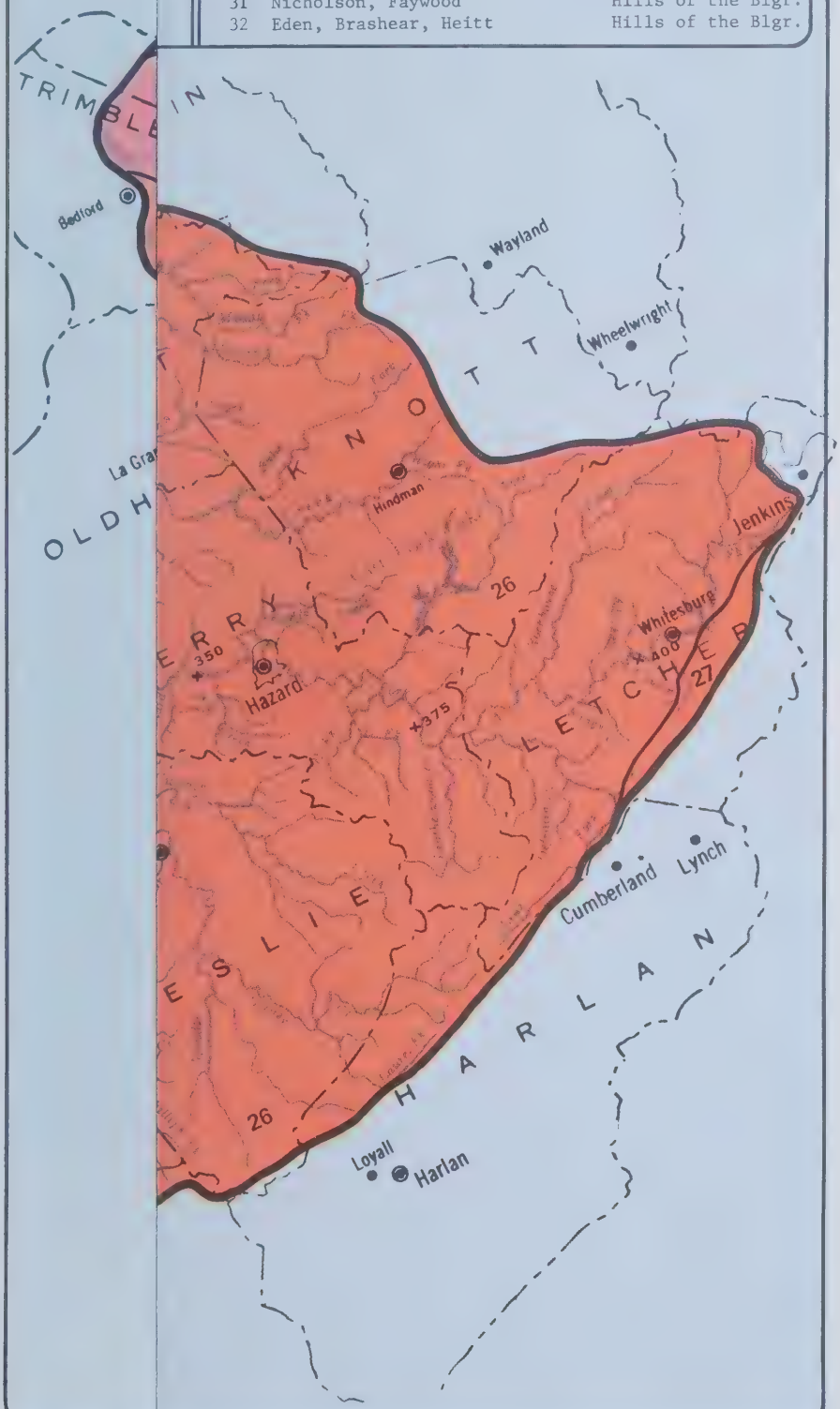
26	Shelocta, Jefferson, Weikert	Mtn. & Coal Flds.
27	Shelocta, Rock Outcrop	Mtn. & Coal Flds.
28	Wheeling, Huntington	Outer Bluegrass
29	Fairmount, Lowell	Outer Bluegrass
30	Captina, Licking, Nolin	Hills of the Blgr.
31	Nicholson, Faywood	Hills of the Blgr.
32	Eden, Brashear, Heitt	Hills of the Blgr.



KENTUCKY RIVER BASIN

EXHIBIT 3.5m

SOIL INTERPRETATION

FOR LAND APPLICATION

LEGEND

- ⊢ 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- 20 SOIL ASSOCIATION NUMBER

SUITABILITY FOR LAND APPLICATION OF WASTEWATER (2-6% Slopes)

- SLIGHT LIMITATION
- MODERATE LIMITATION
- SEVERE LIMITATION

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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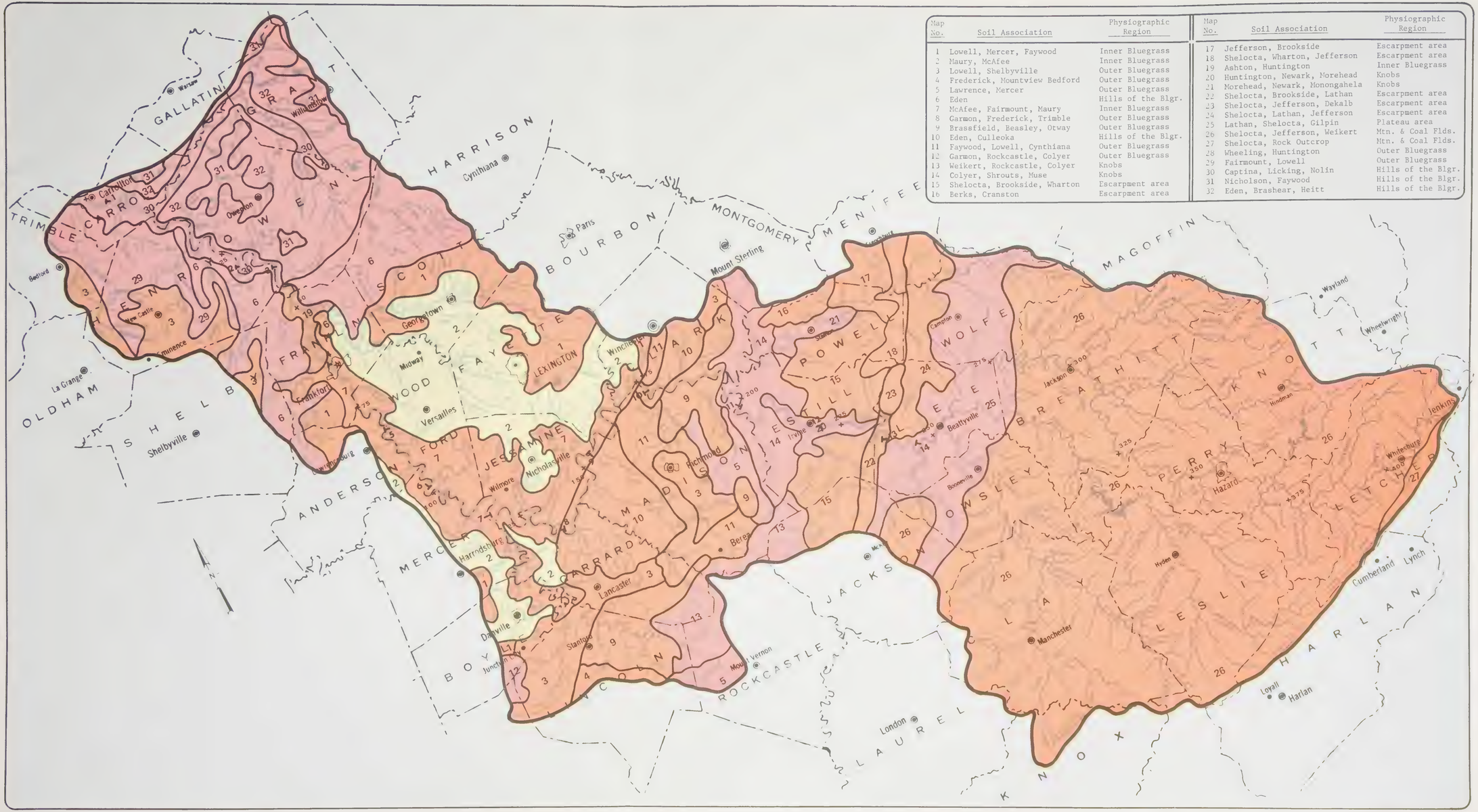

Map No.	Soil Association	Physiographic Region
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2	Maury, McAfee	Inner Bluegrass
3	Lowell, Shelbyville	Outer Bluegrass
4	Frederick, Mountview Bedford	Outer Bluegrass
5	Lawrence, Mercer	Outer Bluegrass
6	Eden	Hills of the Blgr.
7	McAfee, Fairmount, Maury	Inner Bluegrass
8	Garmon, Frederick, Trimble	Outer Bluegrass
9	Brassfield, Beasley, Otway	Outer Bluegrass
10	Eden, Gulleoka	Hills of the Blgr.
11	Faywood, Lowell, Cynthiana	Outer Bluegrass
12	Garmon, Rockcastle, Colyer	Outer Bluegrass
13	Weikert, Rockcastle, Colyer	Knobs
14	Colyer, Shrouts, Muse	Knobs
15	Shelocta, Brookside, Wharton	Escarpment area
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17	Jefferson, Brookside	Escarpment area
18	Shelocta, Wharton, Jefferson	Escarpment area
19	Ashton, Huntington	Inner Bluegrass
20	Huntington, Newark, Morehead	Knobs
21	Morehead, Newark, Monongahela	Knobs
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KENTUCKY RIVER BASIN

EXHIBIT 3.5m

SOIL INTERPRETATION

FOR LAND APPLICATION

LEGEND

- ⊢ 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- 20 SOIL ASSOCIATION NUMBER

SUITABILITY FOR LAND APPLICATION OF WASTEWATER (2-6% Slopes)

- SLIGHT LIMITATION
- MODERATE LIMITATION
- SEVERE LIMITATION

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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the Pottsville Escarpment are erosional remnants of the Pennsylvanian and Mississippian Formations. The resistance to weathering of the sandstone conglomerates and limestone has produced the sharp contrast in relief compared with the more severely eroded, softer shale formations on both sides of the Escarpment Area.

Gas and oil are produced in many areas in the Eastern Coal Field Region. The chief centers of production in the Kentucky River Basin are located in Estill, Lee, and Breathitt Counties. Oil, and infrequently gas, may introduce pollution into streams. In the production of oil, large quantities of brines are pumped from the wells with the oil. If, in the process of separation, the brines are discarded into the streams, the result is a stream with corrosive characteristics due to high concentrations of chloride and increased hardness. Current drilling regulations require that brines be returned to the strata from which they were pumped to avoid this problem of surface water pollution.

Water emerging from the Headwater Section in the main stem of the Kentucky River tends to be somewhat higher in sodium and chloride or sulfate than water entering the river in tributaries draining the limestone and shale formations in the Bluegrass Section. Mixing of water draining this region tends to decrease the sulfate content and increase the total dissolved mineral content. Also, calcium makes up an increasing larger part of the dissolved mineral content. In general, sufficient mixing has occurred by the time water in the Kentucky River reaches Frankfort so that the chemical character of the Kentucky River is similar to that in Elkhorn Creek at Frankfort. Elkhorn Creek is a stream located entirely within the Bluegrass Region. Water in the Kentucky River tends to be of good quality with lower concentrations of hardness, dissolved solids, bicarbonate, and nitrate than most other streams and groundwater entering in the Bluegrass Region (62).

The Kentucky River follows meandering loops as it crosses the Bluegrass Region in a deeply entrenched 350- to 450-foot valley. The meandering stream course is a feature of an old age river, yet the deep narrow valley of the Kentucky River is the picture of youth, the beginnings of a cycle of erosion. The implied contradiction is a record of events combining features of old age and youth. In mid-Tertiary (about 30 million years ago) central Kentucky was a low land (peneplain) a few hundred feet above sea level across which the Kentucky River flowed as an old meandering stream, its work done. Regional uplift of 500 to 600 feet rejuvenated all streams, and the Kentucky River again actively eroding, carved out a young valley following the meandering loops inherited from the earlier cycle. The Kentucky River gorge is crowded with massive limestone cliffs of the Highbridge Limestone. The limestone formations are hard to erode and are responsible for the sheer cliffs in the gorge. Tributaries are similarly deep, cliff-bound gashes in the upland with numerous waterfalls, and the whole vicinity is rugged and picturesque (45).

About 90 percent of the Bluegrass Region is underlain by limestone and shale rocks of Ordovician age (about 450 million years old). The Ordovician rocks that underlie the Inner Bluegrass are limestones of the Cynthiana, Lexington, and Highbridge formations. Those that underlie the Hills of the Bluegrass are shale of the Eden formation, which are easily eroded. The Outer Bluegrass is underlain by Ordovician soft limestones and shale of the Maysville and Richmond formations and by Silurian rocks of the Brassfield formation. Outcropping of the gray-limestone Brassfield formation mark the beginning of the Knobs Region. As mentioned earlier in this section, the Knobs are erosional remnants of Mississippian and Pennsylvanian limestone and sandstone formations. The Knobs are underlain by Silurian and Devonian soft shales.

Soils

Soils in the Kentucky River Basin reflect the type of geologic parent material and topographic position in which they have developed. Upland areas are primarily residual soils that have weathered from limestone, shale, siltstone, or sandstone parent material with a possible influence of loess, windblown silt, in the surface layers. Younger alluvial soils are present along stream and river bottoms throughout the basin.

The Soil Conservation Service identifies 31 soil associations within the Kentucky River Basin, each named for the major soil series which comprises the association. Interpretations are made in EXHIBIT 3.3t for soil parameters affecting water quality management. Included are soil suitability for septic tank absorption fields, for land application of treated wastewater, and for potential sediment runoff on each of the dominant soil series. The percent of association shown in column 3 gives an indication of the approximate proportion of land area for each soil series. Minor soils make up the remainder of each area. The dominant slope shown for each soil series identifies the general topographic position where the soil is normally located. For example, Coyler, a soil developed in residuum of black shales, is normally found on 20 to 60 percent slopes, or steep hillsides, while Newark, an alluvial bottom soil, is normally located on 0 to 2 percent slopes.

Where the degree of limitation is shown as slight, soil properties are generally favorable; moderate indicates that soil properties or site features are unfavorable but that the limitation may be minimized by special planning and design; and severe indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in site preparation, special design, or intensive maintenance is required. For soils rated severe, such costly measures are often not feasible.

The interpretations for land application of treated wastewater (2-6% slopes) were prepared by the Soil Conservation Service based on an interim rating guide; therefore, they are preliminary and subject to change. The assumption is made that the wastewater is nontoxic and biodegradable. In determination of the degree of limitation, soil slope was held constant at a desirable 2 to 6 percent slope. Therefore, soils rated as having a slight or moderate limitation on gentle slope may have a rating of severe if the slope on which the soil is located is steep enough to increase the runoff potential.

Location of the major soil associations within the Kentucky River Basin is shown in EXHIBIT 3.4m and 3.5m. A legend on each identifies the dominant physiographic region for each soil association; the physiographic regions are shown on EXHIBIT 3.1m. A

Exhibit 3.3t - Soil Interpretations

Map No.	Soil Association	Percent of Association	Dominant Slope %	Septic Tank * Absorption Field (2-6% Slopes)	Land Application of Wastewater (2-6% Slopes)	Hydrologic Soil Group **	Potential Sediment Runoff***
1	Lowell	40	2-12	Severe (P)	Moderate (P)	C	Medium
	Mercer	20	0-6	Severe (P)	Severe (P)	C	Medium
	Faywood	10	6-20	Severe (P)	Moderate (P)	C	Medium
2	Maury	50	2-12	Slight	Slight	B	Low
	McAfee	30	6-20	Severe (P)	Moderate (P)	C	Medium
3	Lowell	35	2-20	Severe (P)	Moderate (P)	C	Medium
	Shelbyville	30	2-12	Slight	Slight	B	Low
4	Frederick	25	6-20	Moderate (P)	Slight	B	Medium
	Mountview	23	2-12	Slight	Slight	B	Low
	Bedford	21	0-6	Severe (P)	Severe (P)	C	Medium
5	Lawrence	40	0-4	Severe (P)	Severe (P)	C	Medium
	Mercer	30	2-6	Severe (P)	Severe (P)	C	Medium
6	Eden	91	20-30	Severe (P)	Severe (P)	C	High
7	McAfee	35	6-20	Severe (P)	Moderate (P)	C	Medium
	Fairmount	30	20-50	Severe (P)	Severe (P)	D	High
	Maury	10	2-12	Slight	Slight	B	Low
8	Garmon	33	30-40	Severe (S, D)	Severe (D)	C	High
	Frederick	20	6-12	Moderate (P)	Slight	B	Medium
	Trimble	11	12-20	Slight	Slight	B	Medium
9	Brassfield	27	20-30	Severe (D)	Slight	B	High
	Beasley	26	2-12	Severe (P)	Moderate (P)	C	Medium
	Otway	20	20-30	Severe (P)	Moderate (P)	D	High
10	Eden	40	20-35	Severe (P)	Severe (P)	C	High
	Culleoka	40	12-35	Severe (D)	Slight	B	High
11	Faywood	25	6-20	Severe (D, P)	Moderate (P)	C	Medium
	Lowell	25	2-12	Severe (P)	Moderate (P)	C	Medium
	Cynthiana	25	20-30	Severe (D, P)	Severe (P)	D	High
12	Garmon	42	30-40	Severe (S, D)	Severe (D)	C	High
	Rockcastle	25	20-30	Severe (S, P, D)	Severe (P)	D	High
	Colyer	12	12-30	Severe (D, S)	Severe (D)	D	High
13	Weikert	27	20-60	Severe (D)	Severe (D)	D	High
	Rockcastle	22	20-30	Severe (S, P, D)	Severe (P)	D	High
	Colyer	19	12-30	Severe (D, S)	Severe (D)	D	High
14	Colyer	45	20-40	Severe (D, S)	Severe (D)	D	High
	Shrouts	10	20-30	Severe (P)	Severe (P)	D	High
	Muse	10	12-20	Severe (S)	Moderate (P)	C	Medium
15	Shelocta	35	25-40	Slight	Slight	B	High
	Brookside	24	30-45	Severe (P)	Moderate (P)	C	High
	Wharton	10	2-20	Severe (P)	Severe (P)	C	Medium

* Limitations: P = Percolation; S = Slope; D = Shallow Depth; F = Flooding

**

Hydrologic Soil Group	Infiltration Rate
A	High
B	Moderate
C	Slow
D	Very Slow

Source: Soil Conservation Service
Engineering Design Manual for Kentucky, 1970.

*** Interpretation for Sediment Runoff is based on dominant slope and hydrologic soil group only. Rainfall factor, vegetative cover and conservation practices are held constant.

Exhibit 3.3t - Soil Interpretations

Map No.	Soil Association	Percent of Association	Dominant Slope %	Septic Tank * Absorption Field (2-6% Slopes)	Land Application of Wastewater (2-6% Slopes)	Hydrologic Soil Group **	Potential Sediment Runoff***
16	Berks	36	30-50	Severe (D, S)	Moderate (D, S)	B	High
	Cranston	36	25-40	Moderate (S)	Slight	B	High
17	Jefferson	36	12-30	Moderate (S)	Slight	B	High
	Brookside	32	12-30	Severe (P)	Moderate (P)	C	High
18	Shelocta	37	25-40	Slight	Slight	B	High
	Wharton	18	2-20	Severe (P)	Severe (P)	C	Medium
	Jefferson	18	12-30	Moderate (P)	Slight	B	High
19	Ashton	34	0-6	Slight	Slight	B	Low
	Huntington	30	0-4	Severe (F)	Severe (F)	B	Low
20	Huntington	32	0-4	Severe (F)	Severe (F)	B	Low
	Newark	18	0-2	Severe (F)	Severe (F)	C	Medium
	Morehead	16	0-4	Moderate (F)	Slight	C	Medium
21	Morehead	26	0-4	Moderate (F)	Slight	C	Medium
	Newark	25	0-2	Severe (F)	Severe (F)	C	Medium
	Monongahela	13	0-4	Severe (P)	Severe (P)	C	Medium
22	Shelocta	33	25-40	Slight	Slight	B	High
	Brookside	22	30-45	Severe (P)	Moderate (P)	C	High
	Lathan	11	2-20	Severe (P)	Severe (P)	D	High
23	Shelocta	10	25-40	Slight	Slight	B	High
	Jefferson	6	12-30	Moderate (S)	Slight	B	High
	Dekalb	5	6-20	Severe (D)	Moderate (D)	B	Medium
24	Shelocta	34	25-40	Slight	Slight	B	High
	Lathan	24	2-20	Severe (P)	Severe (P)	D	High
	Jefferson	13	12-30	Moderate (S)	Slight	B	High
25	Lathan	50	2-20	Severe (P)	Severe (P)	D	High
	Shelocta	20	25-40	Slight	Slight	B	High
	Gilpin	15	12-20	Severe (D)	Slight	B	Medium
26	Shelocta	60	25-40	Slight	Slight	B	High
	Jefferson	20	12-30	Moderate (S)	Slight	B	High
	Weikert	10	20-60	Severe (D)	Severe (D)	D	High
27	Shelocta	47	25-40	Slight	Slight	B	High
	Rock Outcrop	14		Severe (D)	Severe (D)		
28	Wheeling	21	0-6	Slight	Slight	B	Low
	Huntington	21	0-4	Severe (F)	Severe (F)	B	Low
29	Fairmount	67	20-50	Severe (P)	Severe (P)	D	High
	Lowell	10	2-12	Severe (P)	Moderate (P)	C	Medium
30	Captina	19	2-12	Severe (P)	Severe (P)	C	Medium
	Licking	19	6-20	Severe (P)	Severe (P)	C	Medium
	Nolin	12	0-4	Severe (F)	Severe (F)	B	Low
31	Nicholson	38	0-8	Severe (P)	Severe (P)	C	Medium
	Faywood	38	6-20	Severe (D, P)	Moderate (P)	C	Medium
32	Eden	95	20-30	Severe (P)	Severe (P)	C	High
	Brashear	1	2-20	Severe (P)	Moderate (P)	C	Medium
	Heitt	1	6-12	Severe (P)	Moderate (P)	C	Medium

Source: Soil Conservation Service

summary interpretation is made for soil suitability for septic tank absorption fields in Exhibit 3.4m, and a summary interpretation for land application of wastewater is shown in EXHIBIT 3.5m. Soil limitations indicated by color-coding on these two exhibits represent an average of interpretations made for individual soil series within each association presented in columns 5 and 6 of EXHIBIT 3.3t. For example, the Maury-McAfee association (No. 2) is comprised of a 50 percent Maury, a deep, well-drained limestone soil, having a slight limitation for drain fields, and 30 percent McAfee, a shallow limestone soil, having a severe limitation because of slow percolation and shallow depth to rock. Therefore, the association is shown on EXHIBIT 3.4m as having a moderate limitation for septic tank absorption fields located on 2 to 6 percent slopes. The suitability of any given area within the Maury-McAfee association can vary from slight to severe limitation.

Before further discussion of soil interpretation made in EXHIBITs 3.3t, 3.4m and 3.5m, emphasis should be made that soil associations are useful to identify the general pattern of soils rather than a specific soil in a given location. Detailed information as to identification of soil type in a specific location within the Kentucky River Basin is available from the Soil Conservation Service. Published soil surveys are available for Fayette, Clark, Madison, Estill, and Lee Counties. A reconnaissance soil survey has been completed for 14 counties in Eastern Kentucky which identifies soil series in the headwaters of the Kentucky River. Mapping is in progress for most other counties in the basin and, if requested, detailed soil maps will be prepared by SCS for specific land parcels almost anywhere in the basin.

A general discussion of the relationship of soils in the Kentucky River Basin to their physiographic region may be helpful to understanding the soil interpretations. The brief discussion of soil characteristics starting at the headwaters and progressing downstream through the basin, follows:

Soils in the Mountains and Eastern Coal Field region formed in residuum or colluvium from acid siltstones, sandstones and shales. The rugged mountains have shallow soils on the steep hillsides and deep, colluvial soils toward the base of the hills in the narrow valleys. The important soil series are Shelocta, Jefferson and Brookside. All three soils are deep, well-drained colluvial soils located toward the base of the mountainsides and on benches. Shelocta soils developed in colluvium from shale and siltstone; Jefferson soils developed in colluvium from sandstone escarpments; and Brookside soils developed in colluvium below limestone cliffs.

In the Knobs Region, soils on conical hills developed from Mississippian and Devonian shales and sandstones and are chiefly in the Rockcastle and Coyler series. Both the Rockcastle and Colyer soils are shallow, clayey soils that have developed in acid shale residuum on steep hillsides. Soils in flatter areas are generally poorly drained because of the presence of a fragipan, or compacted silt layer, which restricts internal drainage.

Soils in the Outer Bluegrass developed in weathered Ordovician limestone overlain, in places, by a loess mantle. The area is suited to general farming; the principal soil series are Lowell, Shelbyville, and Fairmont. The Lowell and Shelbyville soils are generally found on gently sloping areas; Lowell developed from calcareous siltstone and limestone, and Shelbyville weathered from a high-grade limestone. Steeper slopes generally contain Fairmount soils; they are shallow and developed from thin-bedded limestone.

The strongly-dissected hillsides and narrow-crested ridgetops in the Hills of the Bluegrass region have soils derived from Ordovician limestones, calcareous shales, and siltstones. Impervious shale bedrock restricts percolation, causing high runoff rates and rather intensive geologic erosion rates. The important soil series are Eden, Nicholson, and Lowell. Eden soils, normally found on ridgetops, are moderately deep and developed over calcareous shale. The Nicholson soils developed on steep hillsides in residuum from thin-bedded limestone and shale.

Soils in the Inner Bluegrass developed from high-phosphate Ordovician limestones with, in places, a loess mantle. The soils are suited to general agriculture and are especially well-suited to burley tobacco and grassland. Maury, found on gentler slopes, and McAfee, located on steeper areas, are the principal soil series in the region.

Land Application of Wastewater - Feasibility of land application of treated wastewater must be given full consideration for each "201 Facilities Plan", as set forth in the following excerpts from a memorandum to EPA Regional Administrators from Deputy Administrator John Quarles dated November 1, 1974:

> "Land application of wastewater is practiced successfully and extensively in the United States. Many land treatment systems have been in continuous use since 1900. It is apparent from this long-term experience and documented research work that land treatment technology is a viable alternative to be considered as part of waste management systems.
>
> In Section 201 of the Federal Water Control Amendments of 1972, it declares that:
>
> 'Waste treatment management plans and practices shall provide for the application of the best practical waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water, and confined disposal of pollutants so they will not migrate to cause water or other environmental pollution and shall provide for consideration of advance waste treatment techniques.'
>
> In addition, the Cost Effectiveness Analysis Regulations which apply to all projects subject to best practicable treatment state that:
>
> All feasible alternative waste management systems shall be initially identified. These alternatives should include systems discharging to receiving waters, systems using land or surface disposal techniques, and systems employing the reuse of wastewater."

Soil suitability for septic tank absorption fields and for land application of wastewater are closely related; for each, soil is used as a living filter, with the differences being the type of treat-

ment prior to discharge into or on the soil and the method of discharge. For these soil interpretations, the assumption is that wastewater for land application has received secondary treatment with chlorination prior to discharge.

The basic difference in the method of discharge between the two systems is depth of application and timing. A septic tank drain field is generally located 3 to 4 feet below the surface, and the rate of discharge is based entirely on usage of the system rather than soil conditions. Failure of the drain field generally occurs in wet weather when effluent is discharged into a soil with a temporary high water table, resulting in surfacing of the effluent and a serious potential health hazard. Therefore, soil percolation rate under saturated conditions, slope, shallow depth, and potential flooding must be evaluated under the most adverse situation. Interpretations for septic tank absroption fields are generally moderate to severe throughout the Kentucky River Basin, as shown in EXHIBIT 3.4m.

Land application of treated wastewater is normally made on the surface through a sprinkler system at a controlled rate below the hydraulic loading capacity of the soil to prevent surface runoff. However, overload flow systems for land application of wastewater do use a high rate of application, and runoff is collected and monitored prior to discharge into a stream or lake (23).

Removal of 98% of the BOD and suspended solids, 85% of the nitrogen, and 80 to 99 percent of phosphorous is entirely feasible for an irrigation-type land application system (23). Most of this nutrient removal occurs within the biologically-active surface layer of soil, so soil depth is not as critical a factor as for septic tank drain fields. For a land application system 5 feet or more of soil over a moderately permeable bedrock is generally necessary to permit an adequate hydraulic loading capacity.

Even more important than the difference in depth of application is the fact that land application of treated wastewater can be controlled or adjusted to meet weather and soil conditions. Adequate storage capacity is generally designed into the system to minimize the need to apply water during saturated or frozen conditions. Therefore, soil limitations for land application of wastewater are somewhat less restrictive than those for septic tank drain fields, as is indicated by the comparison of interpretations made by the Soil Conservation Service in columns 5 and 6 of EXHIBIT 3.3t.

Slope is obviously an important factor for both drain fields and land application systems. Within each soil association shown in Exhibits 3.4m and 3.5m, is a wide variation of surface slope; therefore, interpretations for septic tank absorption fields and land application of wastewater are made for an optimum slope of 2 to 6 percent, and the slope limitation is considered separately. For septic tank absorption fields, the Soil Conservation Service assigns a moderate limitation for slopes of 6 to 12 percent and a severe limitation for soils on slopes steeper than 12% (20).

Surfacing of effluent in areas down-slope from the drain fields under saturated conditions is, of course, the primary slope limitation. Stair-stepping the drain lines along the contours will improve a steep slope condition by utilizing more of the soil depth. Again, slope would be more of a restriction for drain fields where flow is uncontrolled than for land application systems where the rate of application can be adjusted low enough to prevent runoff or saturation.

Slopes up to 15 percent are acceptable for crop irrigation of treated wastewater provided runoff or erosion is controlled (23). Hillside spraying on steeper slopes has been demonstrated to be a practical approach to disposal of treated domestic wastewater in many mountainous areas of the country (58). Studies have demonstrated that land disposal systems are much more reliable than systems which discharge effluent directly into mountain waters, and the containment of wastes on land is achievable even under the most adverse conditions. Spray application in wooded areas on colluvial soils toward the base of steep hillsides is the general approach to mountain areas where the steep slopes are unsuitable for agricultural operations. This approach has particular relevance in the Mountains and Eastern Coal Field Region of the Kentucky River Basin, where slopes are more of a limitation than are the soils themselves.

The Shelocta-Jefferson-Weikert association has a moderate limitation for septic tank drain fields and land application of wastewater for slopes of 2 to 6 percent. Shelocta, a colluvial soil toward the base of the mountains, represents about 60 percent of the association and has a slight limitation on flat slopes. However, the dominant slope on which Shelocta is normally located is 25 to 40 percent, so the slope limitation for septic tank drain fields would normally be severe. The colluvial soils are normally deep with adequate infiltration rates, so consideration could be given to land application system in forested areas on the steeper slopes.

Soils in the Knobs region generally have a severe limitation for drain fields or land application due to shallow depth on the knobs and slow percolation on the flatter areas.

In the Hills of the Bluegrass region, suitability of soils for drain fields and land application is generally severe because of impermeable shale bedrock restricting percolation and steep slopes. Eden, by far the dominant soil in the northeast corner of the basin, has severe limitation because of tight clay subsoil over impermeable shale. Eden is a good soil for excavated ponds but is unfavorable for wastewater application.

Limestone soils of the Outer and Inner Bluegrass regions are generally more suitable for absorption fields and land application than are those of the Hills of the Bluegrass. However, for any type of land treatment system in karst topography, a major consideration must be made for sinkholes or discontinuities in bedrock limestone formations that might

provide short circuits to the groundwater supply. Because of the larger area involved, sinkholes would be more of a restriction for surface application of wastewater than for individual drain fields. For example, Maury, a dominant soil on gentle slopes of the Inner Bluegrass, has a slight limitation from a soil standpoint for land application, but it may have a severe limitation in any given area because of sinkholes. A buffer zone would be necessary around sinkholes to prevent direct application of treated wastewater to the low point of the sinkhole. This consideration is site specific, and its feasibility would need to be evaluated on an individual basis in "201 Facilities Plans" using detailed topographic and geologic maps.

To summarize the feasibility of land treatment of wastewater in the Kentucky River Basin, the soils in many areas of the Inner and Outer Bluegrass, and the Mountains and Eastern Coal Field physiographic regions appear suitable for land application systems. Evaluation of alternative sites for any particular system would need to consider closely the presence of sinkholes in the Bluegrass Section and topography in the Headwater Section.

Sediment Runoff - Geologic erosion is a natural phenomenon resulting in the diverse terrain throughout the Kentucky River Basin. The primary erosion concern in water quality management planning is to identify where man's activity has accelerated natural erosion, resulting in increased sediment load in streams and down-stream sedimentation. Examples would include surface mining, construction activity for urban expansion, and agricultural tillage operations. Knowledge of the potential sediment runoff for soils in the basin is beneficial for evaluating areas where potential erosion is greatest.

Soil erosion is affected by rainfall intensity and duration, by type of vegetation, by topography, by man's activity (e.g., tillage, grading and conservation practices) and by soil type. For evaluating potential sediment runoff of soil in the Kentucky River Basin, all factors were held constant except for the hydraulic soil group, an indicator of the infiltration and percolation rate of a soil, and the dominant slope of the soil series. Interpretation for the potential sediment runoff is presented in the last column of EXHIBIT 3.3t.

The hydraulic soil groups presented in EXHIBIT 3.3t are classified by the Soil Conservation Service (20) in the following four categories according to their infiltration and transmission rates:

A. (Low runoff potential). Soils having high infiltration rates even when thoroughly wetted. These consist chiefly of deep, well-to-excessively-drained sands or gravels. These soils have a high rate of water transmission; water readily passes through them.

B. Soils having moderate infiltration rates when thoroughly wetted. These consist chiefly of moderately-deep to deep, moderately-well to well-drained soils with moderately-fine to moderately-coarse textures. These soils have a moderate rate of water transmission.

C. Soils having slow infiltration when thoroughly wetted. These consist chiefly of soils with a layer that impedes downward movement of water or soils with moderately-fine to fine texture. These soils have a slow rate of water transmission.

D. (High runoff potential). Soils having very slow infiltration rates when thoroughly wetted. These consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

Interpretation for potential sediment runoff for individual soil series within each association was made based on the dominant slope and the hydrologic soil group using criteria set up in the following table:

Potential Sediment Runoff	Hydrologic Soil Group	Dominant Slope
Low	A, B	Less than 6%
Medium	C	6 - 20%
High	D	Steeper than 20%

In general, the more severe limitation was given where the hydraulic soil group and dominant slope did not correspond. A soil with a hydraulic soil group of B and dominant slope of 35 to 50% was given a high potential sediment runoff limitation.

Most soils in the Kentucky River Basin have a medium or high potential sediment runoff under disturbed conditions. This fact, combined with increased mining activity in the headwaters, urban expansion throughout the basin, and normal agricultural activity, results in a considerable sediment load in the Kentucky River and its tributaries. Water used in cities and factories must be clarified by sedimentation and filtration or by use of silting basins. Lakes may be filled with sediment, destroying their aquatic ecosystems and aesthetic value. The sediment problem is, of course, more severe during periods of flooding.

From a planning standpoint, little can be done to reduce the sediment load caused by background geologic erosion. This would include soil eroded by rainfall onto native vegetation on existing slopes. However, since man's activity is by far the most important factor in accelerated erosion, these activities will be identified as non-point sources of pollution in later sections of this report.

Hydrology

Precipitation furnishes all of the water that flows in the streams in Kentucky. Water enters the streams either directly from surface runoff or

indirectly by infiltration with the ground and reappearance on the surface through springs or seeps. Thus, during dry weather, groundwater furnishes the base flow for streams.

The average or normal yearly precipitation in the Kentucky River Basin ranges between 42 inches in the northern portion to 48 inches in the southwestern mountainous areas of the basin (19). Precipitation is distributed fairly uniformly throughout the year; however, flooding during the spring months is a common occurrence, particularly for smaller streams in mountainous areas. Heavy rainfall is frequently 3 to 4 inches, occasionally 6 inches, but rarely as much as 10 inches in a 24-hour period. Thunderstorms are frequent from March through September.

To show the annual variation in precipitation in the basin, the Lexington area is used as an example. The maximum rainfall in a 24-hour period at Lexington was 8.06 inches on August 2, 1932 (62). Normal monthly totals, based on the period 1931-60, are fairly uniform, as follows:

Month	Normal Precipitation (Inches)
January	4.94
February	3.42
March	4.75
April	4.04
May	3.85
June	4.72
July	3.98
August	3.21
September	2.80
October	2.28
November	3.29
December	3.45
Total	44.73

Source: Precipitation Probabilities for Kentucky (19).

The most precipitation in one month was 16.65 inches, which occurred in January 1950. The least was 0.11 inch in September 1924. In spite of these extremes, precipitation in Lexington and the entire Kentucky River Basin is more nearly the same for all months than in most other parts of the world.

The Kentucky River Basin averages nearly 46 inches of precipitation each year. About 63 percent of this amount returns to the air through evaporation and transpiration, about 28 percent runs off the surface directly into streams, and about 9 percent enters the ground to supply wells and springs that eventually flow into streams (39).

Variations occur throughout the basin. For example, during the summer months evapo-transpiration would tend to be somewhat higher in the forest-covered Headwater Section of the basin than in the agricultural areas of the Bluegrass Section. Within the basin there is also a considerable difference in the amount of runoff and the amount entering groundwater. Runoff is higher in Mountains and Eastern Coal Field and in the Hills of the Bluegrass than it is in the Inner and Outer Bluegrass regions. In the limestone areas of the Bluegrass a larger proportion enters groundwater through numerous sinkholes.

Navigation System - The navigation system on the Kentucky River involves 14 locks and dams which provide for a minimum depth of 6.0 feet to the upper limit of the project at mile 254.8. Data for the locks are shown in EXHIBIT 3.6t.

The dams restrict flow and cause a decrease in reaeration rates, thereby causing the dissolved oxygen content to be reduced when an organic load is imposed on the stream. Furthermore, the slow-moving water allows suspended solids to settle, causing sludge deposits which impose a greater demand on dissolved oxygen and which can hamper navigation unless removed. The channel in the Kentucky River is frequently constricted, particularly at or below the mouths of tributary streams. The Corps of Engineers maintains the channel for commercial navigation between the mouth of the Kentucky River and Frankfort, and for passage of pleasure craft from Frankfort to Beattyville.

Lakes - There are no natural lakes in the Kentucky River Basin. For many thousands of years erosion of the land by streams has been able to keep up with geologic changes. Raising and lowering of the surface by geologic forces have occurred slowly and through a long period of time. Thus, no streams were dammed, and natural drainage systems were not changed.

To help meet water-supply needs and to protect against floods, many artificial lakes and reservoirs of all sizes have been constructed in the basin. They range in size from farm ponds to Herrington Lake, which has a surface area of 3,000 acres and a capacity of 230,000 acre-feet. The only lakes considered in this report are those whose volume is greater than 1,000 acre-feet or whose surface area is greater than 100 acres. There are 15 lakes in the Kentucky River Basin which meet this criterion (See EXHIBIT 3.7t). They have a total combined volume of 286,000 acre-feet and total combined surface area of 6,530 acres.

Two of these lakes, Buckhorn and Carr Fork, are Federal installations with a combined volume of 28,500 acre-feet. The Buckhorn Lake (22,000 acre-feet) is regulated to meet flood, recreation, fish and wildlife and low-flow augmentation objectives. Streams below the lake are benefited through low-flow augmentation during dry periods by means of dilution and reaeration. Carr Fork (6,500 acre-feet) has not been in operation long enough to determine its effects upon the stream below it.

Stream Flow Characteristics - Flow, or discharge, of a stream can vary tremendously between flood conditions and drought. The most critical period for water quality is during times of low flow when natural dilution and reaeration, or assimilative capacity, of the stream are at their lowest levels. The lowest flows of a stream each year usually occur

Exhibit 3.6t

Locks and Dams on the Kentucky River

Lock No.	Miles Above Mouth	Drainage Area (Sq.Mi.)	Pool Length Above Dam (Miles)	Normal Pool Elevation (feet msl)
1	4.0	6,956	27.0	428
2	31.0	6,180	11.0	441
3	42.0	5,983	23.0	454
4	65.0	5,412	17.2	469
5	82.2	5,225	14.0	484
6	96.2	5,102	20.8	497
7	117.0	5,036	22.9	513
8	139.9	4,424	17.6	531
9	157.5	4,101	18.9	549
10	176.4	3,955	24.6	566
11	201.0	3,219	19.9	583
12	220.9	2,916	19.0	600
13	239.9	2,784	9.1	618
14	249.0	2,657	-	634

Source: Navigation Charts, U. S. Army Corps of Engineers, Louisville District

in late summer or fall. Low-flow characteristics are important for control of water quality, for analysis of potential water-supply capacity, and for the management of recreation potential.

The U.S. Geological Survey has been gathering low-flow data on streams throughout Kentucky for several decades. A summary of the low-flow characteristics of major streams in the state is presented in a map prepared by Richard Swisshelm, Jr. (60). The low-flow characteristics for 28 monitoring stations located on streams within the Kentucky River Basin are included. The 7-day, 10-year low-flow characteristics for streams in the basin, shown on Exhibit 3.8m, are primarily based on values reported by Swisshelm and are supplemented by interpolation as a later component of this plan.

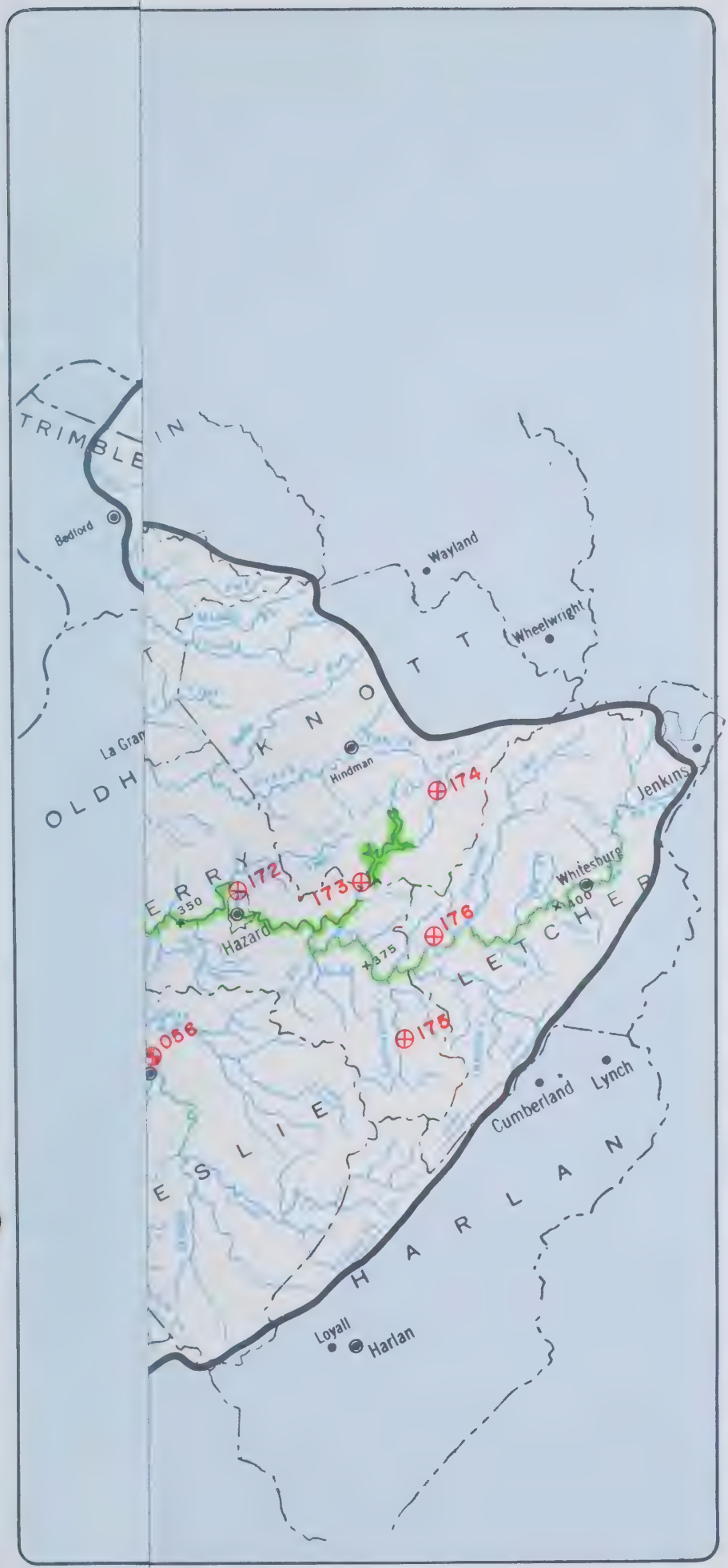
Primary and secondary water quality monitoring stations proposed by the Kentucky Department for Natural Resources and Environmental Protection Division of Water Quality are also shown in EXHIBIT 3.8m.

The 7-day, 10-year low flow is defined as the lowest mean discharge for a 7-day period on an annual basis with a frequency recurrence interval of 10 years. A more detailed definition by Swisshelm (60) follows:

> "Where more than 10 years of record are available, the 7-day annual low flows are used to define a frequency curve. The discharge at 10-year recurrence interval from that curve is the 7-day Q10 which may be interpreted as follows. The probability is 0.1 that any 7-day annual low-flow will be less than the 7-day Q10; or the 7-day annual low-flows will be less than the 7-day Q10 at intervals averaging 10 years in length."

The low-flow characteristics for streams in the Kentucky River Basin (EXHIBIT 3.8m) show that the 7-day, 10-year low flow is less than 0.1 cfs for most smaller streams in the basin. On the other hand, low-flow augmentation of 25 cfs from Carr Fork Lake, 150 cfs from Buckhorn Lake, and 100 cfs from Herrington Lane improve the low flow characteristics of North Fork and Middle Fork Kentucky River, and Dix River, respectively. The South Fork Kentucky River has a 7-day, 10-year low flow of 0.1 cfs where Goose Creek and Redbird River join, and 0.6 cfs at Booneville. The low-flow at the gaging station downstream from Stanton on Red River is 2.8 cfs, and the gage on Elkhorn Creek near Frankfort has a reported value of 4.9 cfs (60).

The 7-day, 10-year low flows shown in EXHIBIT 3.8m do not include augmentation from wastewater



KENTUCKY RIVER BASIN

EXHIBIT 3.8m

STREAM FLOW CHARACTERISTICS

LEGEND

- ⊢5 LOCK AND DAM NUMBER
- +50 RIVER MILE

7 DAY, 10 YEAR LOW FLOW (cfs)

- GREATER THAN 10
- 1.0 to 10
- 0.1 to 1
- 0 to 0.1

WATER QUALITY MONITORING

- ◒100 PRIMARY STATIONS
- ⊕100 SECONDARY STATIONS

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Miller, Wihry & Lee
INCORPORATED
Landscape Architects and Engineers
Landward House • 1387 South Fourth Street • Louisville, Kentucky

KENTUCKY RIVER BASIN

EXHIBIT 3.8m

STREAM FLOW CHARACTERISTICS

LEGEND

- ⊢5 LOCK AND DAM NUMBER
- +50 RIVER MILE

7 DAY , 10 YEAR LOW FLOW (cfs)

- GREATER THAN 10
- 1.0 to 10
- 0.1 to 1
- 0 to 0.1

WATER QUALITY MONITORING

- ◔100 PRIMARY STATIONS
- ⊕100 SECONDARY STATIONS

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality
KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Miller, Wihry & Lee
INCORPORATED
Landscape Architects and Engineers
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Exhibit 3.7t

Lakes in the Kentucky River Basin

Location	County	Surface Area (Acres)	Capacity Acre-Feet
Fishpond Lake	Letcher County	31	1,037
Taylor Fork Lake	Madison County	169	3,572
Corinth Lake	Grant County	96	1,612
Bullock Pen	Grant County	134	2,464
Elmer Davis Lake	Owen County	149	3,151
Pan Bowl Lake	Jackson County	98	1,298
Lexington Reservoirs	Fayette County	408	3,850
Mill Creek Lake	Wolfe County	41	1,049
Elk Lake	Owen County	207	2,654
Herrington Lake	Mercer County	2,940	230,500
Kentucky Utility Fly Ash Disposal	Carroll County	89	2,491
Lake Vega	Madison County	132	1,557
Boltz Lake	Grant County	92	2,168
TOTAL	----------	4,586	257,403
Federal			
Buckhorn Lake	Leslie & Perry Counties	1,230	21,800
Carr Fork Lake	Knott County	710	6,480
TOTAL	----------	1,940	28,280
GRAND TOTAL	----------	6,526	285,683

Source: Kentucky Department for Natural Resources and Environmental Protection, Division of Water Resources.

treatment facilities. The most significant example in the basin is Lexington Town Branch Plant, which discharges 18 MGD (28 cfs) into the South Fork Elkhorn Creek. Discharge rates from various treatment facilities in the basin will be discussed in later sections of this report.

The average normal flow of the Kentucky River at Locks 14, 10, and 4 are 3,853 cfs, 5,233 cfs and 7,042 cfs respectively (EXHIBIT 3.9t). The average yield of the basin is 1.33 cubic feet per second per square mile throughout the main stem of the river.

There are two water withdrawals in the basin that are significant to water quality. The City of Lexington withdraws about 28 MGD from the Kentucky River through intake pipes located about halfway between Locks 9 and 10, but discharges to tributaries which enter the river below Lock 8 and Lock 4. The City of Winchester withdraws 1.5 MGD from the Kentucky River but discharges to another basin. These two withdrawals are not put back in the river above Lock 8 near Camp Nelson and, therefore, reduce the 7-day, 10 year low flow at the lock by 29.5 MGD, or approximately 20 percent. This reduced low flow can affect the waste load allocation and subsequent treatment levels required for the cities of Richmond and Berea.

The City of Lawrenceburg also withdraws from the Kentucky River and discharges into another basin, but this withdrawal has no significant impact on water quality.

Exhibit 3.9t Surface Water Records for the Kentucky River Basin

Station	Period of Record	Drainage Area	Average Flow	Maximum Flow	Minimum Flow	7 day 10 yr. Low Flow
N. Fork Ky. River at Hazard	34 yr.	466 sq. mi.	572 cfs, 1.2 cfs* / sq. mi.	47,800 cfs, 103 cfs / sq. mi.	Not Determined	27.9 cfs
Lock 14 near Heidelberg	42 yr.	2,657 sq. mi.	3,853 cfs, 1.4 cfs / sq. mi.	120,000 cfs, 45 cfs / sq. mi.	4.0 cfs, 0 cfs / sq. mi.	177.9 cfs
Lock 10 near Winchester	67 yr.	3,955 sq. mi.	5,233 cfs, 1.3 cfs / sq. mi.	92,400 cfs, 23 cfs / sq. mi.	10.0 cfs, 0 cfs / sq. mi.	180.3 cfs
Lock 4 near Frankfort	49 yr.	5,412 sq. mi.	7,042 cfs, 1.3 cfs / sq. mi.	115,000 cfs, 21 cfs / sq. mi.	Not Determined	280.3 cfs
Elkhorn Creek Near Frankfort	37 yr.	473 sq. mi.	604 cfs, 1.3 cfs / sq. mi.	23,200 cfs, 49 cfs / sq. mi.	0 cfs, 0 cfs / sq. mi.	4.9 cfs

* Cubic Feet Per Second

NOTE: Data is taken from "Surface Water Records in Kentucky" by the United States Geological Survey. The 7 day 10 year low flow was taken from the waste load allocation produced as a component of this plan.

Groundwater - The occurrence and quality of groundwater in the basin is closely related to the type of existing geologic formation. Fresh and slightly saline water is found at depths ranging from less than 100 feet to more than 2,000 feet below land surface in the Kentucky River Basin. The fresh-saline water interface, the common boundary between fresh water and saline water, is identified throughout the state on a detailed map prepared by Herbert Hopkins (28). In the Kentucky River Basin, the shallowest depths of the fresh-saline water interface, ranging from 25 to 350 feet below land surface, occur in the Bluegrass Region. The greatest depths of fresh water are found in the Eastern Coal Field Region, where the interface ranges from 200 to more than 2,000 feet below land surface.

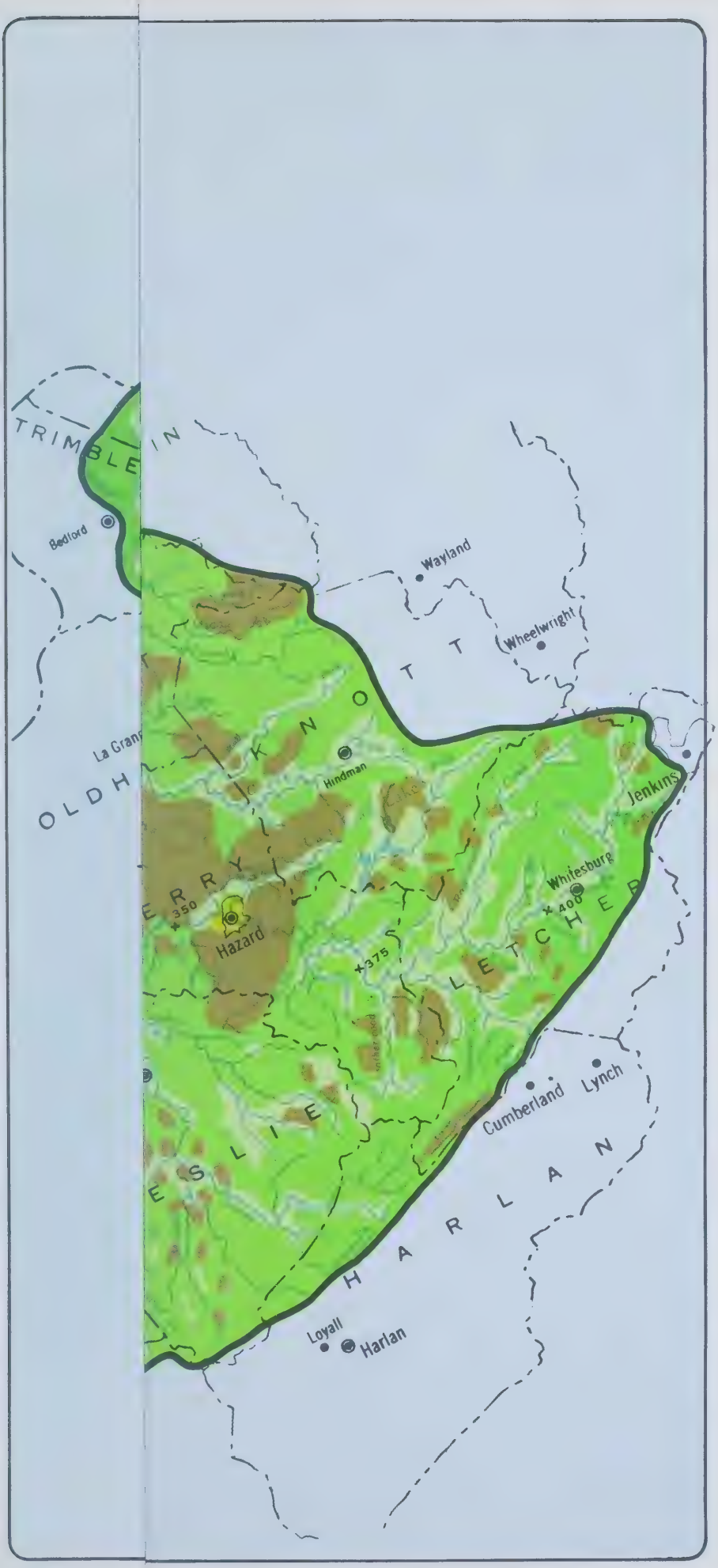
The difference in the composition of the underlying rocks causes variations in the type of subsurface openings through which groundwater flows. In sandstone, siltstone, shale, and coal, the major groundwater flow is along joint systems, fractures, and bedding planes. However, there is some flow through intergranular spaces. In limestones the major groundwater flow is through openings enlarged by solution along joint systems, fractures and bedding planes.

Chemical characteristics of groundwater are important in river basin planning since groundwater furnishes the base flow for streams during periods of dry weather. Water entering streams through springs, seeps, and the pores and cracks in the soil and rock along stream banks provides the background level of chemical characteristics for the stream.

The general groundwater quality for the different physiographic areas in the basin is summarized in the table on Exhibit 3.1m. Groundwater in the Bluegrass and Knobs regions is classified as "hard" with calcium carbonate levels generally ranging between 250 and 600 ppm. The water above the fresh-saline interface ranges from a calcium magnesium bicarbonate type to a sodium chloride type, and that below the interface generally is a sodium bicarbonate or sodium chloride type. The change from fresh to saline water near the interface is characterisized by a sharp increase in chloride, sulfate, hardness, and occasionally iron. Fresh water concentrations of sulfate in the Inner and Outer Bluegrass areas are generally less than 100 ppm. However, sulfate in excess of 150 ppm is common in the area underlain by Devonian shale and the Eden Group in the Hills of the Bluegrass area.

In the Inner Bluegrass, most wells drilled in the limestone bedrock yield enough water for home use. A few wells in the valleys of major streams yield 50 to 200 gallons per minute for public and industrial water supplies (39). Nearly all successful wells in bedrock are less than 100 feet deep, because salt water may occur about 200 feet. Conditions for wells are even less favorable in the Outer Bluegrass region because the limestone beds are thinner and there is more inner-bedded shale. About half the wells drilled in limestone bedrock yield enough water for domestic use. Where shale or shaly limestone forms bedrock, wells generally do not yield enough water for home use. Throughout the Bluegrass Region, about one-eighth of the wells are reported to yield water containing undesirable amounts of sodium and chloride, and about one-fifth of the wells yield water containing noticeable amounts of hydrogen sulfide (50).

In the Eastern Coal Field region, bedrock of sandstone, siltstone, and conglomerate yields to most wells drilled in valleys enough water for home use. About 50 wells yield more than 50 gallons per minute for public and industrial water supplies (39). Few wells are drilled more than 200 feet deep for fear of encountering salt water. The calcium carbonate content of well water is generally 25 to 150 ppm, or moderately soft, and the sulfate content is high in water draining from deep mines and strip mine spoil



KENTUCKY RIVER BASIN

EXHIBIT 3.10m

LAND USE MAP

LEGEND

- 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE

- AGRICULTURE
- SILVICULTURE
- MINING
- URBAN

5 0 10 20

GRAPHIC SCALE IN MILES

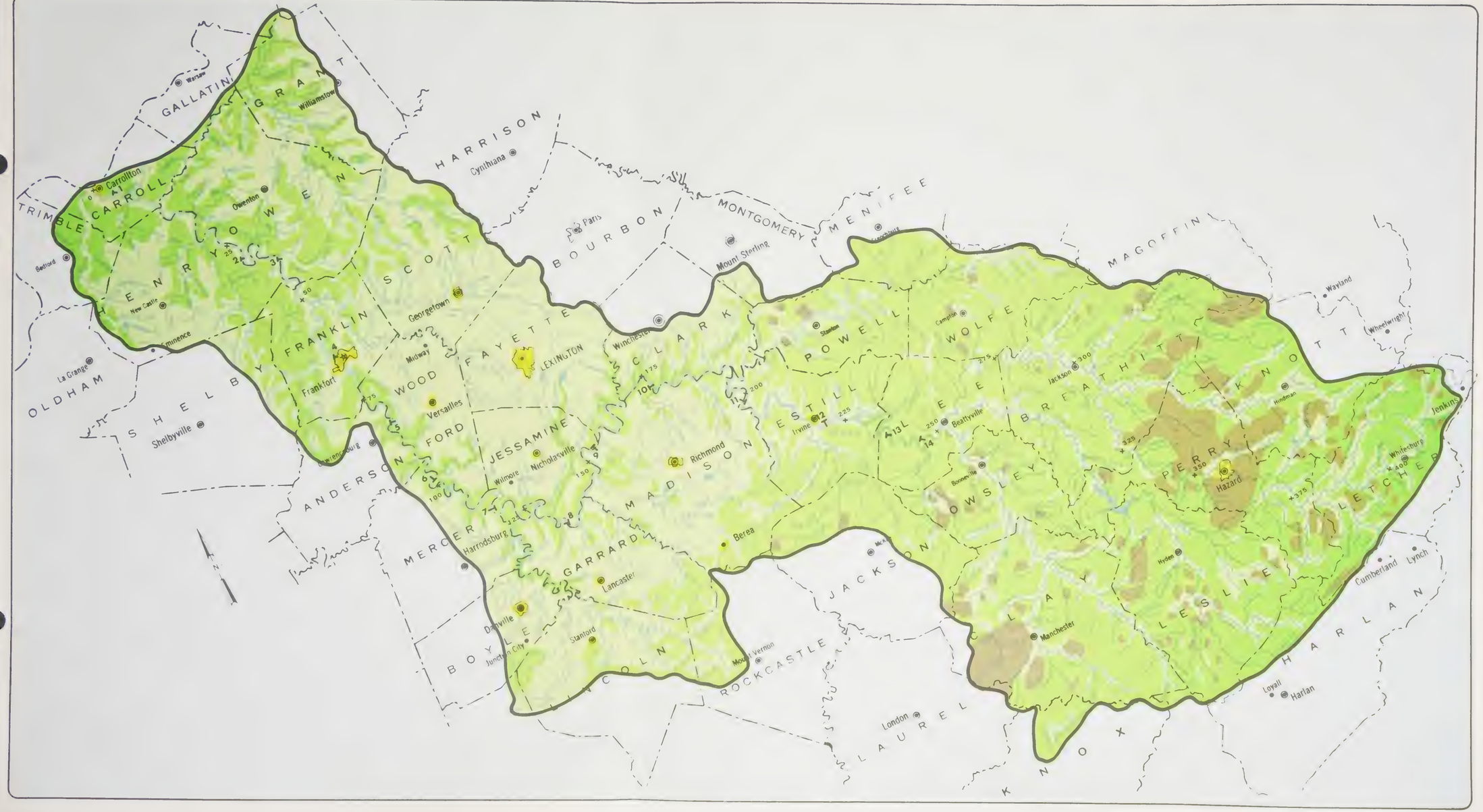
Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Miller, Wihry & Lee
INCORPORATED
Landscape Architects and Engineers
Landward House • 1387 South Fourth Street • Louisville, Kentucky



KENTUCKY RIVER BASIN

EXHIBIT 3.10m

LAND USE MAP

LEGEND

- 5 LOCK AND DAM NUMBER
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piles. Numerous small springs are present in the area, but most go dry in summer.

Groundwater moves through the Pennsylvanian shale, sandstone, and coal primarily in small openings along joint systems, fractures, and bedding planes. Because of the higher permeability, the numerous points of discharge as springs and seeps, and the limited solubility of the Pennsylvanian rocks, the quality of groundwater is not readily altered and the fresh-saline water interface is relatively deep beneath the upland. Near the streams underlain by Mississippian rocks, the development of large solution openings and flushing of connate or saline water occur at greater depths than beneath the upland area; therefore, fresh water is found at maximum depths within the valleys.

Contact springs occur where coal seams overlie water-tight clay beds. Water moves through fractures in the coal seam above the tight shale to places where the coal bed reaches the surface where it flows out as a small spring. The sulfate content is generally high in ground water emerging from coal seams.

KENTUCKY RIVER BASIN LAND USE

A graphic depiction of land use within the Kentucky River Basin is presented in EXHIBIT 3.10m and is presented in tabular form in EXHIBIT 3.11t. Of the 7,071 square miles which comprise the surface area of the Kentucky River Basin, approximately 98% is classified rural and 2% is classified as urban.

The basin is characterized by numerous active farms in the northern and Bluegrass sectors, with less intensive farming taking place in the limited level areas and hollows of the mountainous southeastern region of the basin.

Urban areas in the northern portion of the basin include Carrollton in Carroll County and Frankfort in Franklin County. Within the Inner Bluegrass Region, urban centers are more numerous and include Lexington, Georgetown, Versailles and Nicholasville. Within the Outer Bluegrass Region are located the cities of Danville, Lancaster, Richmond and Berea. Finally, the sparsely populated Appalachian portion of the basin contains only two urban centers, Irvine-Ravenna in Estill County and Hazard in Perry County.

Significant underground and surface mining activity is currently taking place in the Kentucky River Basin counties of Breathitt, Clay, Harlan, Knott, Knox, Leslie, Letcher and Perry. As can be seen in EXHIBIT 3.12t,the number of mines, the number of employees and the number of tons of coal produced in the Kentucky River Basin has increased steadily since 1968, reflecting the increased dependence of the country on coal resources as a source of energy.

Of the area within the basin classified "rural", an estimated 3,322 square miles is devoted to agriculture, 3,637 to forest and woodland and some 10 square miles to "permitted" surface mining activity. By 1995, it is estimated that an additional 57 square miles of agricultural land will be given over to urban uses either in urban areas or in rural non-farm communities.

The major federal installation in the basin is the Lexington-Bluegrass Army Depot with facilities in Fayette and Madison Counties. The Depot is a major electronics maintenance facility as well as a general supply and ammunition storage area and employs some 4,000 workers.

Increased mining activity is expected to occur within the basin in the future and the trend toward larger farm holdings will likely continue. In addition, increased areas at the fringe of urban and rural non-farm communities will be given over to urban uses as the basin's population becomes more urban. Several proposed Corps of Engineer reservoirs will likely be built during the next 20 years, providing additional recreation opportunities in the area.

KENTUCKY RIVER BASIN POPULATION

Population projections for the Kentucky River Basin are presented in EXHIBIT 3.13t. Methodologies utilized in the development of the socioeconomic and land use data for the Kentucky River Basin are detailed in Appendix A.

The population within the Kentucky River Basin in 1975 was estimated to be 569,863, or approximately 16.8% of the population of the State. An estimated 51.5% of the 1975 basin population is urban and 48.5% percent is rural.

All or part of the thirty-nine counties are located within the Kentucky River Basin which encompasses 7,071 square miles of surface area and represent approximately 18% of the total area of Kentucky. The bulk of the Kentucky River Basin is located within the Bluegrass and Kentucky River ADDs, with lesser portions falling within the boundaries of the Northern Kentucky, KIPDA, Gateway and Cumber Valley District.

A major share of the population in the basin is concentrated in the Inner Bluegrass Region in Fayette, Madison, Franklin, Scott and Woodford Counties. Lexington is the only SMSA in the basin with an estimated 1975 population of 183,373 and projected to increase to 277,018 by 1995. Other urban areas within the basin include Carrollton, Frankfort, Georgetown, Versailles, Nicholasville, Richmond, Berea, Danville, Lancaster, Stanford, Irvine-Ravenna, and Hazard.

Population in the Kentucky River Basin is projected to increase to 739,138 by 1995, 61.2% of which is estimated to be urban and 38.8% to be rural, reflecting Kentucky's continuing trend from a rural to more urban society.

Exhibit 3 11t Land Use Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year or Projected Land Area (Sq.Mi.)				Between Year Number / % Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Thirty-Nine County Total	11,159.8	11,159.8	11,159.8	11,159.8	-	-	-
Out of Basin Area	4,088.1	4,088.1	4,088.1	4,088.1	-	-	-
In Ky.River Basin Area	7,071.7	7,071.7	7,071.7	7,071.7	-	-	-
Rural Area	6,970.7	6,961.9	6,950.9	6,913.3	-8.8 / -0.1%	-11.0 / -0.1%	-37.6 / -0.5%
Agriculture	3,322.7	3,313.9	3,302.9	3,265.3	-8.8 / -0.2%	-11.0 / -0.3%	-37.6 / -1.1%
Silviculture	3,637.4	3,637.4	3,637.4	3,637.4	-	-	-
Mining Related	10.6	10.6	10.6	10.6	-	-	-
Construction Related	-	8.8	11.0	37.6	-	2.2 / 25.0%	26.6 /242.0%
Urban Area	101.0	109.8	120.8	158.4	8.8 / 8.0%	11.0 / 10.0%	37.6 / 31.1%

Exhibit 3.12t Annual Coal Production for Kentucky River Basin Counties

County	1968			1971			1974		
	Tons Produced	Number of Employees	Number of Mines	Tons Produced	Number of Employees	Number of Mines	Tons Produced	Number of Employees	Number of Mines
Breathitt	1,637,135	297	16	3,872,962	723	31	5,109,650	855	63
Clay	653,659	517	32	818,832	433	47	690,163	585	66
Harlan	7,909,272	2,480	134	8,729,322	2,676	146	10,217,133	3,350	179
Jackson	12,800	13	4	19,535	22	4	53,750	64	19
Knott	2,018,603	681	86	3,836,588	1,437	130	4,573,203	1,886	180
Knox	164,597	234	58	1,320,599	557	80	1,498,734	836	117
Lee	26,780	57	7	31,202	29	4	245,409	99	13
Leslie	1,729,935	808	36	1,911,475	638	50	3,050,731	740	160
Letcher	6,033,202	2,253	206	6,116,541	2,668	212	5,471,572	2,533	313
Owsley	160	6	3	28,000	4	1	317,759	109	16
Perry	4,389,150	1,465	105	7,155,559	1,832	126	5,537,652	1,795	134
Wolfe	100	2	1	16,063	31	5	13,942	11	5
TOTAL	25,575,393	8,813	681	33,856,658	11,024	831	36,779,698	12,863	1,230

Source: Annual Reports, Kentucky Department of Mines and Minerals, Lexington, Kentucky.

Counties within the Kentucky River Basin which experienced a population increase of 10% or greater between 1960 and 1970 included Fayette, Franklin, Montogmery, Scott, Woodford, Jessamine, Clark, Madison, and Powell. Counties which experienced a decrease in population during the period included Henry and Owen in the northern sector of the basin and Menifee, Wolfe, Lee, Breathitt, Garrard, Rockcastle, Jackson, Owsley, Clay, Knox, Bell, Harlan, Letcher, Perry and Knott in the southern sector of the basin.

The declines in population during the 1960-1970 decade in the Appalachian Counties of the basin can be attributed to a number of factors including insufficient employment opportunities for area residents, due in part to the isolation of the region and the scarcity of improved sites suitable for industrial development and a decline in coal production.

However, since 1964 with the enactment of the Appalachian Development Program, a multifaceted effort was launched to reverse the out-migration trend in the Appalachian Region. Since 1964, large sums of money have been spent on highway construction to improve access to the region; on health and educational facilities and programs to improve the well-being and marketable skills of area residents; and, on industrial development efforts to attract new employers to the region.

Success in this effort began to show with the peaking of out-migration from the region in 1968 and a reversal toward in-migration during the mid 70's. A population report released by the Appalachian Regional Commission in December, 1974 estimates that 90,000 people will be added to the population of Eastern Kentucky during the next six years, a portion of which will reside in the Kentucky River

Exhibit 3.13t Population Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Population				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Thirty-Nine County Total	789,142	830,931	881,463	1,065,902	5.3	6.0	20.9
Out of Basin	251,358	261,068	274,298	326,764	3.8	5.1	19.1
In Kentucky River Basin	537,784	569,863	607,165	739,138	5.9	6.5	21.7
Urban	260,777	293,496	327,275	452,302	12.5	11.5	38.2
Rural	277,007	276,367	279,594	282,836	0.2	2.4	2.4
Farm	250,759	248,366	249,682	247,908	0.9	0.6	0.7
Non-Farm	26,248	28,001	29,912	34,928	6.2	6.8	16.7

Exhibit 3.14t Housing Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Occupied Housing Units				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Thirty-Nine County Total	238,928	261,336	286,568	382,852	8.6	8.8	25.1
Out of Basin	76,493	82,751	90,064	116,864	7.5	8.1	22.9
In Kentucky River Basin	162,435	178,585	196,504	265,988	9.0	9.1	26.1
Urban	80,638	93,165	105,497	161,648	13.4	11.7	34.7
Rural	81,797	85,420	90,907	104,340	4.2	6.0	12.8
Farm	73,857	76,563	80,989	91,421	3.5	5.5	11.4
Non-Farm	7,940	8,857	9,918	12,919	10.3	10.7	23.2

Basin. Explanations given by the Commission's report for this reversal include:

- The boom in the coal industry.
- The "rural life movement" of young people moving from cities to the country.
- Increased black-lung and Social Security payments.
- Higher unemployment and housing shortages in northern cities.
- Expansion of recreation and of retirement housing in mountain areas (75).

While the ARC report did not break down population growth by county, U.S. Department of Commerce estimates indicate the most dramatic increases occurring within the Kentucky River Basin counties since 1970 include: Knox with a 10.0% increase; Menifee with an 8.9% increase; Leslie with a 6.9% increase; Knott with a 9.9% increase and Harlan with a 9.1% increase (U.S. Department of Commerce).

Although these recent population estimates were not incorporated into the data base utilized in this study, these initial indicators of population growth should be closely monitored in the continuing planning process for assessment of impacts on water quality and the possible need to adjust segment priorities.

KENTUCKY RIVER BASIN HOUSING UNITS

Housing trends and projections for the Kentucky River Basin are presented in EXHIBIT 3.14t.

Estimates indicate that in 1970 there were over 162,400 units in the Kentucky River Basin, with the number projected to increase over 63% by 1995 to over 265,000 units. Of the 162,400 housing units in the basin in 1970, approximately half were in urban areas and half in areas classified as rural. Of the rural units, over 90% were in the rural farm category while the remaining 10% were located in rural non-farm communities - communities with population under 2,500.

By 1995, it is estimated that over 60% of the housing units in the Kentucky River Basin will be in urban areas and the remaining nearly 40% will be in areas classified as rural. However, it is projected that an increasing share of new rural housing units will be constructed in rural non-farm communities during the next two decades.

KENTUCKY RIVER BASIN EMPLOYMENT

Employment projections for the Kentucky River Basin are presented in EXHIBIT 3.15t.

The number of non-agricultural wage and salary workers in the Kentucky River Basin was estimated to be 153,026 in 1970. By 1995, it is estimated that the number of non-agricultural jobs in the basin will more than double to a total of some 310,119.

Major nonagricultural employment in the Kentucky River Basin is concentrated in the Bluegrass Area Development District with Fayette County the principal employer with 76,808 jobs in 1970, projected to increase over 80% by 1995. Other counties within the Bluegrass ADD with major employers include Franklin, with the State Capitol in Frankfort employing some 7,000 state government workers; Madison County with the Cities of Richmond and Berea; Boyle County and Danville; and Woodford, Clark, and Scott Counties contiguous to Fayette County.

Exhibit 3.15t Employment Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Employment				Between Year Number/Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Thirty-Nine County Total	213,175	274,951	334,496	440,547	61,776/28.9	59,545/21.6	106,051/31.7
Out of Basin	60,149	77,040	98,160	130,428	16,891/28.1	21,120/27.4	32,268/32.8
In Ky. River Basin	153,026	197,911	236,336	310,119	44,885/29.3	38.425/19.4	73,783/31.2

Manufacturing employment in the Bluegrass ADD, which represents approximately 27% of total ADD non-agricultural wage and salary employment, is expected to more than double by 1995. The major share of manufacturing employment in the Bluegrass ADD is in the "machinery, metal products and equipment" category with over 40% of the manufacturing total. The "clothing, textile and leather", "other manufacturing" and "food and kindred products" represent respectively the second, third and fourth largest employment categories in the ADD.

Non-manufacturing employment in the Bluegrass ADD represented approximately 80% of the total non-agricultural employment in the ADD in 1950, decreased to 73% in 1970 and is expected to maintain this level through the study period. Within the non-manufacturing sector of the Bluegrass ADD, the "services" and "finance, insurance and real estate" categories are projected to expand most rapidly.

Future employment in the basin is expected to remain concentrated in and around Fayette County, in counties within the Inner Bluegrass which contain growth centers (Clark, Scott, Woodford, Madison, Franklin and Jessamine) increasing slightly their share of ADD employment growth through 1955.

The Kentucky River ADD, which together with the Bluegrass ADD contains the major share of the Kentucky River Basin area, contrasts markedly with the Bluegrass area. Total employment in the Kentucky River ADD totaled 19,605 in 1950, declined by over 4,000 workers between 1950 and 1960, then increased to near the 1950 total in 1970.

Non-manufacturing employment constitutes more than 96% of total non-agricultural wage and salary employment in the ADD, with "mining and quarrying" and "government" the chief employers, followed by "services" and "wholesale and retail trade".

Manufacturing employment in the ADD, stifled by access and suitably developed industrial sites, constitutes less than 4% of employment in the ADD.

"Lumber and furniture", "food and kindred products" and "machinery, metal products and equipment" have been the principal manufacturing categories in the past in the Kentucky River ADD.

As for the future, non-manufacturing employment in the ADD is expected to more than double by 1995 over the 1970 figure. Within the non-manufacturing sector of the Kentucky River ADD,"mining and quarrying", "government" and the "services" categories are expected to expand most rapidly.

If past trends continue, manufacturing in the ADD is expected to increase only slightly during the study period. However, if the industrial foundations which have been formed in many of the Appalachian counties in the basin are successful in locating, preparing and marketing industrial sites, manufacturing employment could experience significant gains.

At the present time, Perry and Letcher Counties contain the bulk of the Kentucky River ADD employment with 34.9% and 27.4% respectively, while Owsley County contains only 2.3% of the total ADD employment.

EXISTING WATER QUALITY AND APPLICABLE STANDARDS

General

Limited information relating to ground water quality has been discussed on previous pages of this chapter.

Surface water quality varies throughout the river basin and such variation is directly related to man's habitation and activities.

In the headwaters of the Kentucky River Basin, mining and lumbering industries have a profound effect on water quality. Rapid runoff of surface water occurs as a result of removal of vegetation and overburden from coal seams with subsequent siltation of the smaller streams thus obliterating the bottom organisms that serve as food for the higher orders of aquatic life. Coal solids also frequently gain entrance to the waterways and drainage pattern resulting in "Black Water" that contributes additional siltation of stream beds.

In the headwaters section of the basin, surface waters often have considerable sulfate content and is, therefore, slightly acidic. The average slope of the tributaries in this portion of the basin range from 3 feet per mile to 7.2 feet per mile resulting in streams having a moderate assimulative capacity for organic matter.

Karst topography exists throughout the Bluegrass and Hills of the Bluegrass portions of the basin, resulting in numerous springs that feed the main stem of the Kentucky River and its tributaries.

Located in the Bluegrass region are the larger cities of the basin with their attendant water quality problems. The most severe water quality problems occur near Lexington, Richmond, and Frankfort. Other communities that significantly impact on water quality of tributary streams are Owenton, Nicholasville, Campton, Hindman, and Manchester.

Surface water records are meager throughout the basin compared to its size, such data that is available does not contain adequate information relative to pollution parameters with minor exceptions.

The Kentucky River contains fourteen dams that restrict flow and decrease reaeration rates. Reduced velocities above the dams permit sedimentation of suspended solids, thus creating sludge deposits that create an oxygen demand on the stream.

Significant water withdrawals are made by the cities of Lexington and Winchester. Lexington withdraws approximately 28 MGD and Winchester approximately 1.5 MGD. Water withdrawn by Lexington is eventually returned to the Kentucky River by way of Hickman Creek and Elkhorn Creek. Water withdrawn by the City of Winchester is eventually discharged into the Licking River Basin. The City of Lawrenceburg also withdraws raw water from the Kentucky River and discharges into the Salt River Basin, however such withdrawal is insignificant and does not impact on water quality of the Kentucky River.

The average normal flow of the Kentucky River at Locks 14, 10, and 4 are 3583 cubic feet per second (cfs), 5234 cfs and 7042 cfs respectively.

The average yield of the basin is 1.33 cfs per square mile throughout the main stem.

Fifteen lakes are located in the basin having a combined volume of 286,000 acre-feet and a total surface area of 6,530 acres. Buckhorn Lake and Carr Fork Lake are the major impoundments. These are federally owned and have a combined volume of 28,000 acre-feet. Allocation of storage capacity for water quality control has been provided in both lakes.

Surface Water Quality

Existing Water quality may be reflected by the data accumulated from five samplings. The stations are located as follows:

(1) Lock 4 at Frankfort
(2) Lexington Water Plant
(3) North Fork near Hazard
(4) Red River near Pine Ridge
(5) Eagle Creek at Glencoe

The chemical characteristics of the stream when viewed over a long period of time is similar to surface waters. Rock formations, soils and their chemical characteristics are reflected in the water characteristics.

Waters of the Kentucky River Basin are generally moderately hard, caused by salts of calcium and magnesium. In areas that are under the influence of mining operations the sulfate content increases considerably above the bicarbonate content and the pH will generally be below 5.0. Brine waste associated with oil field operations often cause the chloride content to exceed 25 ppm on tributary streams.

Trace elements measured in the Kentucky River Basin are less than the Federal Drinking Water Standards except near Hazard where iron, manganese and fluoride occur primarily as a result of mining activities.

Additional information on existing water quality may be found in APPENDIX A-1.

Point Source Pollution

Based on water quality modeling associated with this report the following segments have water quality problems:

Segment #4 Drennon Creek and Town Branch water quality are effected by the discharge of New Castle, Kentucky.

Segment #8 Ten Mile Creek is frequently degraded by numerous insignificant discharges.

Segment #11 Stevens Creek is suspected of being in violation of dissolved oxygen and ammonia standards.

Segment #12 Kentucky River, the point source discharge for the City of Frankfort in addition to the combined sewer discharges, impacts on water quality of the segment.

Segment #16 Water Quality Standards for North Elkhorn Creek are in frequent violation of the total coliform and fecal coliform

bacteria standards.

Segment #17 South Elkhorn Creek is being degraded as a result of the population concentration of the Lexington area.

Segment #20 Jessamine Creek and Town Branch are being degraded by effluents from plants serving Ashbury and Nicholasville.

Segment #25 Hickman Creek receives the discharges from Lexington's Hickman Creek sewage treatment plant and some violations occur, particularly dissolved oxygen.

Segment #26 Boone Creek will be in violation of the dissolved oxygen water quality standards during a 7 day-10 year low flow frequency.

Segment #27 Water quality of Tates Creek will often be violated as a result of the point source discharge from Richmond, particularly dissolved oxygen.

Segment #28 Water quality of Otter Creek will often be violated as a result of the point source discharge from Richmond, particularly dissolved oxygen.

Segment #31 Clark's River receives the discharge from the City of Danville. Dissolved oxygen violations presently occur frequently.

Segment #33 Logan Creek receives the discharge from the City of Stanford. Dissolved oxygen violations presently occur frequently.

Segment #35 Silver Creek receives the effluent from Berea's wastewater treatment plant. Dissolved Oxygen and ammonia violations occur frequently.

Segment #42 Swift Camp Creek receives the effluent from Campton's wastewater treatment plant. Dissolved oxygen standards are frequently violated.

Segment #50 The City of Hindman discharges into Troublesome Creek. Violation of the dissolved oxygen and ammonia standards will occur frequently.

Segment #51 Goose Creek receives the effluent from the City of Manchester. Dissolved oxygen and ammonia standards will be violated frequently.

Additional information relative to water quality in the above referenced segments may be found in APPENDIX B entitled, SEGMENT ANALYSIS FOR THE KENTUCKY RIVER BASIN.

Non-Point Source Pollution

Non-point source pollution exists from three primary categories; agriculture, mining, and surface runoff. It has been estimated that 1070 square miles of disturbed land exists within the basin and that 1700 miles of stream banks and road banks are eroding excessively, thus contributing to stream sedimentation. Excessive erosion of approximately 54 square miles of surface mining lands is taking place.

With respect to urban runoff, the cities of Lexington, Richmond, Danville, and Frankfort constitute major sources of non-point source pollution in this category.

Non-point source pollution was not considered to be of major significance until relatively recent. It is now estimated that perhaps 40 to 50 percent of the total pollution load is due to non-point source pollution. Additional information is needed.

Existing Water Quality Standards

Four documents have been adopted by the Commonwealth of Kentucky for the purpose of maintaining and enhancing water quality (See APPENDIX C). These are:

(1) WP-4-1 Water Quality Standards for Waters of the Commonwealth, adopted by the State agency 23 July 1971 and amended by the U.S. Environmental Protection Agency on November 25, 1974.

(2) Antidegradation Policy adopted by the State agency 5 March 1971.

(3) WP-6-2 Use Classification of Water, Treatment Requirements and Compliance, adopted by the State agency on November 5, 1973, and amended by the U.S. Environmental Protection Agency on 25 November 1974.

(4) Policy for Addition of Streams Not Shown on Map entitled Streams of Kentucky. This policy was adopted by the State agency on 6 February 1974.

WP-4-1 (Water Quality Standards) contains six sections that sets minimum standards to all "Waters of the Commonwealth of Kentucky". They are:

(1) Public Water Supply and Food Processing
(2) Industrial Water Supply
(3) Aquatic Life
(4) Recreation
(5) Agriculture
(6) Antidegradation Policy

Each stream use classification establishes specific minimum standards for the use intended; however, the regulation further specifies that any waters having more than one use classification assigned, the more stringent use criteria shall apply. Section 6 of WP-4-1 was recently added by the U.S. Environmental Protection Agency. This section provides for exceptions to stream segment classification and/or criteria based on adequate demonstration that water quality levels necessary for aquatic life or secondary contact recreation are not attainable. Such exceptions are temporary and must be reviewed at least every three years.

The Antidegradation Policy simply stated means that any waters now exceeding the applicable standards may not be degraded below their present state unless it can be demonstrated that such lowering of water quality is justified.

WP-6-2 was adopted by the State agency (Department for Natural Resources and Environmental Protection) on November 5, 1973. This document addresses water use classifications, treatment requirements and compliance schedules. The Federal Environmental

Protection Agency amended Section 1(2) of this document so that all waters not shown on the Streams of Kentucky map prepared by the Department of Commerce will include aquatic life and secondary contact recreation criteria. This regulation also indicates that point source discharges must implement best practicable technology by 1 July 1977 and best available technology economically achievable by 1 July 1983. Time schedules for implementation by discharges are also required as well as permit requirements of the Department for Natural Resources and Environmental Protection.

The Department for Natural Resources and Environmental Protection is in the process of implementing five new water quality regulations. These were adopted by the Department on 13 March 1975 and published in the Administrative Register of Kentucky on 1 April 1975. Public hearings on these regulations were held on 13 and 14 of May 1975.

A brief summary of the content of each of the five regulations are listed below:

(1) 401 KAR 5:005, Permits: Requires a permit prior to construction and operation of a wastewater system and sets forth requirements for receiving a permit to construct and operate such a system.

(2) 401 KAR 5:015, Emergency Episodes: Requires that spills and by-passes from waste treatment facilities be reported to the Department for Natural Resources and Environmental Protection.

(3) 401 KAR 5:025, Water Quality Criteria: Provides narrative water quality standards for all waters and sets forth a use classification scheme with numerical criteria for applicable waters.

(4) 401 KAR 5:035, Stream Classification and Treatment Technology: Applies to the use classifications found in Section 3 through 9 of 401 KAR 5:025 to certain waters. Additionally, this regulation mandates that all persons discharging pollutants through point sources shall apply "best practicable control technology" and "best available technology economically achievable" by certain dates.

(5) 401 KAR 5:045, Minimum Degree of Treatment: Requires a minimum of secondary treatment for facilities which receive biodegradable wastes and treatment in excess of secondary in certain situations. This regulation requires that existing facilities receiving such wastes re-apply to the Department for Natural Resources and Environmental Protection prior to January 1, 1976, for a permit to continue operating.

These new regulations, which may undergo minor revisions as a result of input from the public hearing, may be found in their entirety in APPENDIX C. Since these regulations will not become effective in their revised form until after July 1, 1975, and since these regulations basically set stream water quality and treatment requirements identical to those in Kentucky's existing water quality standards, this river basin plan was based on compliance with the four existing water quality regulations of the Commonwealth.

The implication of Kentucky's water quality regulations to river basin planning is that different criteria must be applied to basin streams, depending on whether or not they are shown on the "Streams of Kentucky" map. Streams which are not contained on this map must only meet the following criteria which are applicable to aquatic life and secondary contact recreation:

(1) Dissolved Oxygen: Average daily concentration must be 5.0 mg/1, and concentration must be greater than 4.0 mg/1 at any time - aquatic life use standard.

(2) Fecal Coliform: Average shall not exceed 2,000 per 100 ml, and maximum shall not exceed 4,000 per 100 ml - secondary contact recreation use standard.

All streams in the basin which are shown on the "Streams of Kentucky" map must meet the most stringent criteria of all stream use classifications. Exhibit 3.50t outlines water quality criteria applicable to the five stream use classifications and specifies the quantitative limits on various water quality parameters which vary depending upon stream use. For example, different total coliform levels are permissible for recreational waters as opposed to waters used as public water supplies and for food processing. It is, therefore, possible to develop a generalized water quality violation summary from WP-4-1 parameter limits which describes the most stringent criteria for a stream having all uses excluding a put-and-take trout stream. The following water quality limitations may, therefore, be utilized to determine water quality "violations" in waters classified for all uses, i.e., streams contained on the "Streams of Kentucky" map.

(1) pH: No value below 6.0 nor above 9.0 - aquatic life use standards.

(2) Dissolved Oxygen: Average daily concentration must be 5.0 mg/1, and concentration must be greater than 4.0 mg/1 at any time - aquatic life use standard.

(3) Temperature: Stream maximum temperature for each month in degrees F is:

January	50
February	50
March	60
April	70
May	80
June	87
July	89
August	89
September	87
October	78
November	70
December	57

and maximum temperature increase allowable is 5 degrees F. - aquatic life use standard.

(4) Dissolved Solids: Monthly average not to exceed 500 mg/1 nor 750 mg/1 at any time - public water supply and food processing industries standard.

(5) Fecal Coliform: Not to exceed monthly

geometric mean of 200 per 100 ml during May through October nor 1,000 per 100 ml during November through April - recreation use standard.

(6) Total Coliform Not to exceed monthly average of 1,000 per 100 ml - recreation use standard.

(7) Radioactive Substances: Gross beta activity not to exceed 1,000 picocuries per liter (pCi/l), nor shall activity from dissolved Strontium-90 exceed 10 pCi/l, nor shall activity from dissolved alpha emitters exceed 3 pCi/l - public water supply and food processing industries standard.

(8) Chemical Constituents: Not to exceed the following concentrations in mg/l at any time:

Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium (+6)	0.05
Cyanide	0.025
Fluoride	1.0
Lead	0.05
Selenium	0.01
Silver	0.05

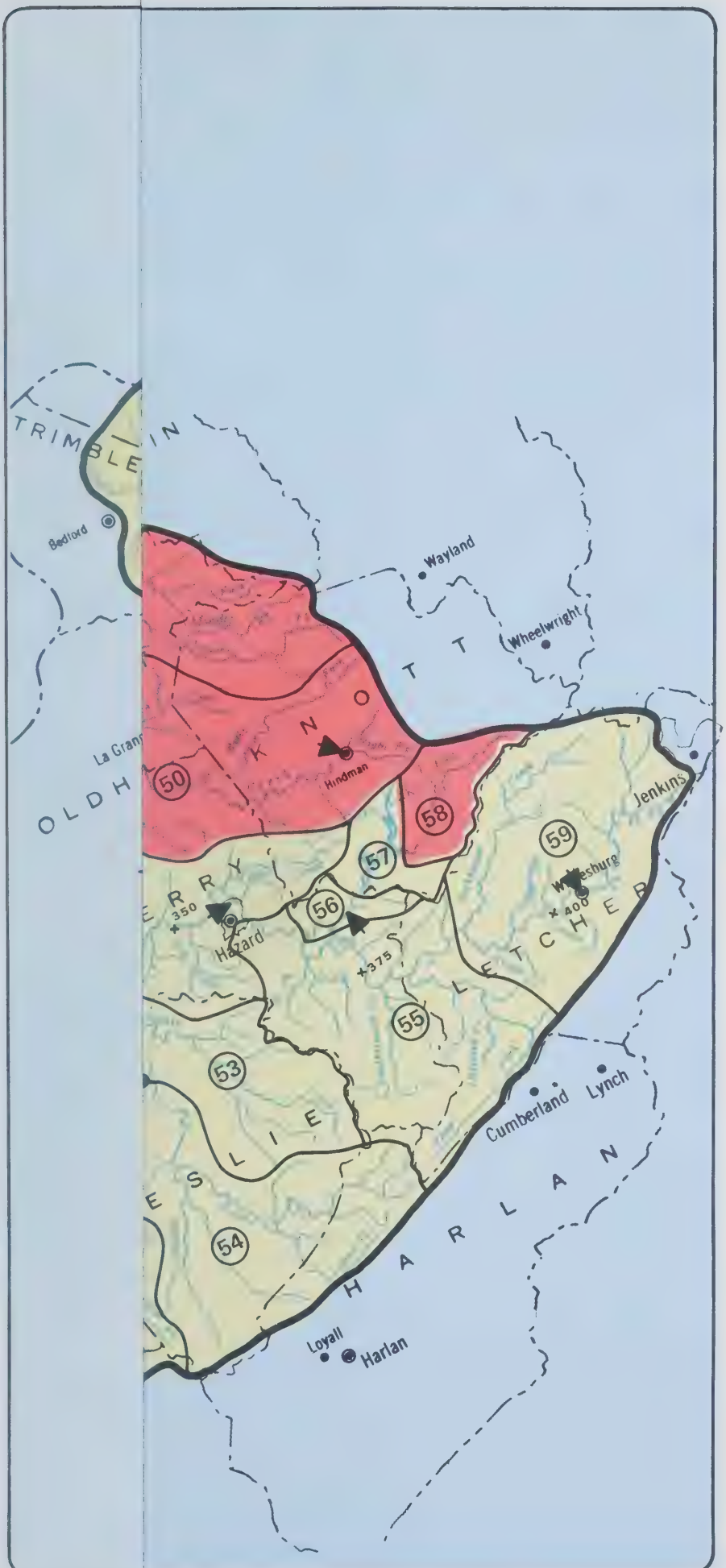
- public water supply and food processing industries standard.

(9) Toxic Substances: Not to exceed one-tenth of the 96-hour median tolerance limit of fish - aquatic life use standard.

(10) Threshold-odor Number: Not to exceed 3 - public water supply and food processing industries standard.

The most significant of the above criteria in terms of violation potential are the average daily dissolved oxygen limit of 5.0 mg/l and average fecal and total coliform bacteria limits of 200 per 100 ml (May through October) and 1,000 per 100 ml, respectively.

Consequently, river basin planning must be developed to meet distinctly different criteria, depending on whether or not the stream under consideration is contained on the map, "Streams of Kentucky"; in which case, the more stringent water quality criteria apply.



KENTUCKY RIVER BASIN

EXHIBIT 4.2m

SEGMENT CLASSIFICATION

LEGEND

- 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- (16) SEGMENT NUMBER
- ▼ DISCHARGE LOCATION

SEGMENT CLASSIFICATION

- WATER QUALITY LIMITED
- EFFLUENT LIMITED

5 0 10 20

GRAPHIC SCALE IN MILES

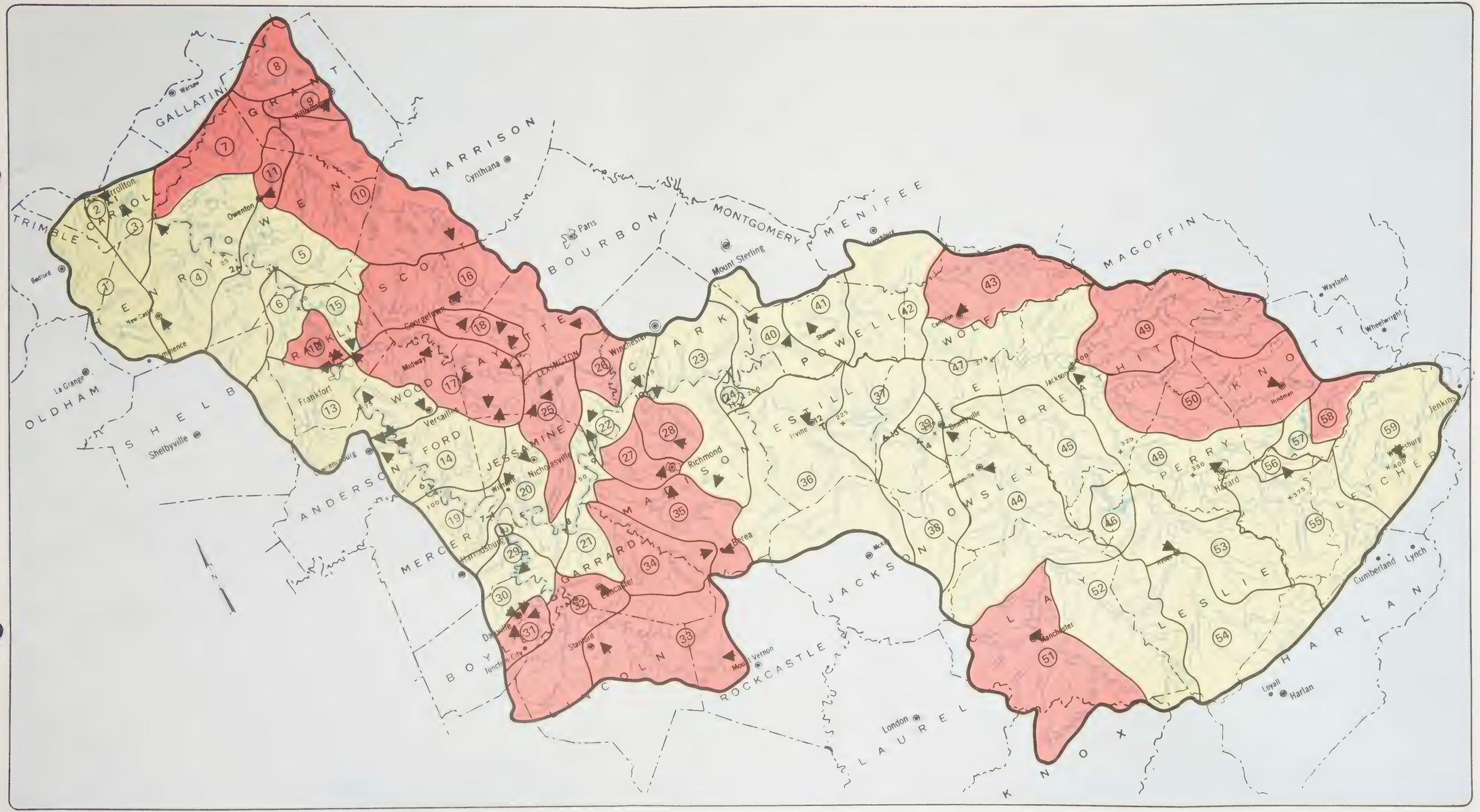
Base Data: U. S. Geoloeical Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Miller, Wihry & Lee
INCORPORATED
Landscape Architects and Engineers
Landward House • 1387 South Fourth Street • Louisville, Kentucky



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CHAPTER 4

WATER QUALITY MANAGMENT STATUS

INTRODUCTION

The purpose of water quality management as specified in Public Law 92-500 (P.L. 92-500), and more explicitly in the Federal Register dated June 3, 1974, Volume 39 Number 107, Part II entitled Water Quality Management Basin Plans, is "to provide the States with the Water Quality Assessment and program Management information necessary to make centralized,coordinated water quality management decisions; to encourage water quality objectives which take into account overall state policies and programs, including those for land use and other related natural resources; and to provide the strategic guidance for developing the annual state program submittal."

As specified in P.L. 92-500, the state must develop a continuing planning process which will be directed toward the attainment of water quality standards established under P.L. 92-500.

Within the scope of the state's continuing planning process, the individual states must develop individual basin plans in accordance with paragraph 303(e) of the above referenced Public Law. These individual basin plans are to establish specific programs and targets for preventing and controlling water pollution in the individual basins. The basin plans must also establish policies that will guide decision making for a five to ten year period.

SEGMENT CLASSIFICATION

Public Law 92-500 requires that river basin planning be predicated on a "segment" concept. The Act defines this term as follows: "The term 'segment' means portion of a basin, the surface water of which have common hydrologic characteristics (or flow regulation pattern); common natural physical, chemical, and biological processes; and common reactions to external stresses, such as discharge of pollutants." Within the Kentucky River Basin, 59 such segments have been identified and designated. (See EXHIBIT 2.1m)

The following criteria for determining segment boundaries were developed by consultants working cooperatively with the State subsequent to intensive interpretation of the segment definition set forth on preceeding pages of this report and further defined in Subpart A -130.2(m) of Volume 39, Number 107 of the Federal Register dated June 3, 1974.

Stream segment delineation criteria were based primarily on a stream's hydrological characteristics and its reaction to external stresses. The stream parameters which were utilized to depict a significant influence on hydrologic characteristics or reactions to external stresses included the 7-day, 10-year low flow (including wastewater dischargers) and the stream bed slope. These two parameters were thought to be of significance since the quantity of flow basically relates to the stream's dilution capabilities; whereas the stream bed slope relates to the reaeration coefficient of the stream segment.

Based on this approach, the following "rules of thumb" were developed to delineate segment boundaries.

1. A segment boundary was established where stream flow became perennial if a significant discharger existed on the zero flow portion of the stream (Flow referenced to 7-day, 10-year low flow frequency).

2. A segment boundary was established at a point on the stream at which a significant 7-day, 10-year low flow change was defined as either:

   a. The point at which one perennial stream confluenced with another perennial stream.

   b. The point at which a significant discharger increased a perennial flow stream by at least ten percent.

3. A stream segment was established to encompass a 7-day, 10-year zero flow stream if it had a significant discharger on it and flowed into a perennial stream.

4. A stream segment boundary was designated where a significant stream slope change occurred, i.e., a slope change greater than 30 percent over at least a ten mile stream length.

5. A stream segment boundary was established where significant hydrological changes occurred such as dams and impoundments.

A significant discharger for the Kentucky River Basin was defined as one having a flow equal to or greater than 50,000 gallons per day.

A tabulation of the segments and their related characteristics is presented in EXHIBIT 4.1t. The river mile description in the second column identifies the location of each segment based on the river mile at the upstream and downstream ends of the segment. A slash (/) symbol separates the upstream and downstream mile points. For example, segment #2 (Kentucky River from confluence with Ohio River to Lock and Dam #1) has a river mile description 435.6-0.0/4.0. The first number designates the Ohio River mile point at the mouth of the Kentucky River and the numbers on either side of the slash give the downstream and upstream mile points of the segment, respectively.

Exhibit 4.1t Segment Description and Water Quality Status

Segment No.	River Mile Description	Location	1975 Segment Classification	1975 Segment Priority (Rank in Basin)	Deviation From National Priorities
1	434.8-0.0	Little Kentucky River	EL	5.2 (45)	No
2	435.6-0.0/ 4.0	Kentucky River from Confluence with Ohio River to Lock and Dam #1	EL	550 (5)	No
3	4.0/ 10.97	Kentucky River from Lock and Dam #1 to Confluence with Eagle Creek	EL	1.9 (56)	No
4	10.97/31.0	Kentucky River from Confluence with Eagle Creek to Lock and Dam #2	EL	340 (11)	No
5	31.0/ 42.0	Kentucky River from Lock and Dam #2 to Lock and Dam #3	EL	4.4 (46)	No
6	42.0/ 51.9	Kentucky River from Lock and Dam #3 to Confluence with Elkhorn Creek	EL	2.0 (55)	No
7	10.97-0/34.6	Eagle Creek from Confluence with Kentucky River to Clark's Creek	WQL	3.5 (49)	No
8	10.97-27.4-0.0/	Ten Mile Creek from Confluence with Eagle Creek to Headwaters	WQL	2.7 (54)	No
9	10.97-34.6-0.0/	Clark's Creek from Confluence with Eagle Creek to Headwaters	WQL	35 (33)	No
10	10.97-34.6	Eagle Creek from Clark's Creek to Headwaters	WQL	83 (24)	No
11	10.97-38.8-0.0/	Stevens Creek from Confluence with Eagle Creek to Headwaters	WQL	93 (23)	No
12	51.9/ 65.0	Kentucky River from Confluence with Elkhorn Creek to Lock and Dam #4	WQL	4600 (2)	No
13	65.0/ 82.5	Kentucky River from Lock and Dam #4 to Lock and Dam #5	EL	185 (15)	No
14	82.5/ 96.2	Kentucky River from Lock and Dam #5 to Lock and Dam #6	EL	18 (40)	No
15	51.9-0.0/17.8	Elkhorn Creek from Confluence with Kentucky River to the forks of Elkhorn Creek	EL	28.7 (35)	No

Exhibit 4.1t Segment Description and Water Quality Status

Segment No.	River Mile Description	Location	1975 Segment Classification	1975 Segment Priority (Rank in Basin)		Deviation From National Priorities
16	51.9- 17.8/	North Elkhorn Creek from Confluence with Elkhorn Creek to Headwaters	WQL	1200	(4)	No
17	51.9-17.8-0.0/	South Elkhorn Creek from Confluence with Elkhorn Creek to Headwaters	WQL	4950	(1)	No
18	51.9-45.3-0.0/	Cane Run from Confluence with North Elkhorn to Headwaters	WQL	190	(14)	No
19	96.2/117.0	Kentucky River from Lock and Dam #6 to Lock and Dam #7	EL	2.9	(53)	No
20	117.0/139.9	Kentucky River from Lock and Dam #7 to Lock and Dam #8	EL	380	(9)	No
21	139.9/157.5	Kentucky River from Lock and Dam #8 to Lock and Dam #9	EL	3.0	(51)	No
22	157.5/176.4	Kentucky River from Lock and Dam #9 to Lock and Dam #10	EL	25	(38)	No
23	176.4/190.8	Kentucky River from Lock and Dam #10 to Confluence with Red River	EL	128	(20)	No
24	190.8/201.0	Kentucky River from Confluence with Red River to Lock and Dam #11	EL	1.0	(58)	No
25	135.3-0.0/	Hickman Creek	WQL	212.5	(13)	No
26	170.6-0.0/	Boone Creek from Confluence with Kentucky River to Headwaters	WQL	67	(25)	No
27	158.1-0.0/	Tate Creek from Confluence with Kentucky River to Headwaters	WQL	390	(7)	No
28	177.3-0.0/	Otter Creek from Confluence with Kentucky River to Headwaters	WQL	495	(6)	No
29	118.2-0.0/3.0	Dix River from Confluence with Kentucky River to Dam	EL	0.1	(59)	No
30	118.2-3.0/26.2	Herrington Lake	EL	56	(28)	No

Exhibit 4.1t Segment Description and Water Quality Status

Segment No.	River Mile Description	Location	1975 Segment Classification	1975 Segment Priority (Rank in Basin)		Deviation From National Priorities
31	118.2-26.2/	Clark's Creek from Confluence with Dix River to Headwaters	WOL	1325	(3)	No
32	118.2-26.2/51.1	Dix River from Herrington Lake to Logan Creek	WOL	170	(16)	No
33	118.2-51.1/	Dix River from Logan Creek to Headwaters	WOL	166	(17)	No
34	146.0-0.0/	Paint Lick Creek from Confluence with Kentucky River to Headwaters	WOL	380	(10)	No
35	150.3-0.0/	Silver Creek from Confluence with Kentucky River to Headwaters	WOL	160	(18)	No
36	201.0/220.9	Kentucky River from Lock and Dam #11 to Lock and Dam #12	EL	16	(42)	No
37	220.9/239.9	Kentucky River from Lock and Dam #12 to Lock and Dam #13	EL	4.0	(48)	No
38	239.9/249.0	Kentucky River from Lock and Dam #13 to Lock and Dam #14	EL	3.4	(50)	No
39	249.0/254.8	Kentucky River from Lock and Dam #14 to Confluence with South Fork Kentucky River	EL	4.0	(47)	No
40	190.8-0.0/21.4	Red River from Confluence with Kentucky River to Brush Creek	EL	5.9	(44)	No
41	190.8-21.4/41.1	Red River from Confluence with Brush Creek to Middle Fork Red River	EL	3.0	(52)	No
42	190.8-41.1/59.5	Red River from Middle Fork Red River to Swift Camp Creek	EL	40	(30)	No
43	190.8-59.5/	Red River from Swift Camp Creek to Headwaters	WOL	1.9	(57)	No
44	254.8-0.0/45.1	South Fork Kentucky River	EL	22.6	(39)	No
45	258.6-0.0/43.26	Middle Fork Kentucky River from Confluence with North Fork to Dam	EL	14.8	(43)	No

Exhibit 4.1t Segment Description and Water Quality Status

Segment No.	River Mile Description	Location	1975 Segment Classification	1975 Segment Priority (Rank in Basin)	Deviation From National Priorities
46	258.6-43.26/60.0	Buckhorn Lake	EL	16.8 (41)	No
47	254.8/300.1	North Fork Kentucky River from Confluence with Kentucky River to Jackson STP	EL	135 (19)	No
48	300.2/361.0	North Fork Kentucky River from Jackson STP to Dam at Hazard Water Plant	EL	390 (8)	No
49	307.8-0.0/	Quicksand Creek from Confluence with Kentucky River to Headwaters	WOL	56.0 (29)	No
50	313.7-0.0/	Troublesome Cr. from Confluence with Kentucky River to Headwaters	WQL	97 (22)	No
51	254.8-45.1-0.0/	Goose Creek from Confluence with South Fork Kentucky River to Headwaters	WOL	231 (12)	No
52	254.8-45.1/	Redbird River from Confluence with South Fork to Headwaters	EL	33.7 (34)	No
53	258.6-60.0/73.5	Middle Fork Kentucky River from Buckhorn Lake to Rockhouse Creek	EL	28 (36)	No
54	258.6-73.5/	Middle Fork Kentucky River from Rockhouse Creek to Headwaters	EL	113.9 (21)	No
55	361.0/388.0	North Fork Kentucky River from Hazard Water Plant to Rockhouse Creek	EL	60.3 (27)	No
56	367.8-0.0/8.78	Carr Fork from Confluence with North Fork Kentucky River to Dam	EL	36.6 (31)	No
57	367.8-8.78/13.5	Carr Fork Lake	EL	25.9 (37)	No
58	367.8-13.5/	Carr Fork Cr. from Confluence with Carr Fork Lake to Confluence with Breeding Creek	WOL	36.3 (32)	No
59	388.0/	North Fork Kentucky River from Rockhouse Cr. to Headwaters	EL	62.6 (26)	No

For segments #3 through #59, the Ohio River mile point is the same (435.6); therefore, the first number designates the mile point for the Kentucky River. Segments including the headwaters for a particular stream would not have an upstream mile point so there is no number to the right of the slash. An example would be segment #54, Middle Fork Kentucky River from Rockhouse Creek to the headwaters. The river mile description is 258.6-73.5/. The first number indicates the river mile of the Kentucky River at the confluence of Middle Fork and the number to the left of the slash is the mile point on Middle Fork at the downstream end of the segment.

The river mile description provides a precise location for segment boundaries and is useful for determining segment lengths, calculating stream slopes, locating point discharges and programming for computer analysis.

METHOD FOR WATER QUALITY AND EFFLUENT LIMITATIONS CLASSIFICATION

Segments have been further defined as either Water Quality, hereinafter designated as Water Quality Limited (WQL) or Effluent Limitations, hereinafter designated as Effluent Limited (EL).

The Federal Environmental Protection Agency (EPA) has defined a Water Quality Segment in the following manner: "Any segment where it is known that water quality does not meet applicable water quality standards and/or is not expected to meet applicable water quality standards even after the application of the effluent limitations required by sections 301(b)(1)(A) and 301(b)(1)(B) of the Act."

Effluent Limitations has been defined by EPA as: "Any segment where it is known that water quality is meeting and will continue to meet applicable water quality standards or where there is adequate demonstration that water quality will meet applicable water quality standards after the application of the effluent limitations required by sections 301(b)(1)(A) and 301(b)(1)(B) of the Act."

EPA has further directed that each classification must reflect necessary allowances for future demographic and economic growth over at least a five year period. An addtiional allowance or margin of safety must be taken into consideration if available data is uncertain or unreliable.

In the Kentucky River Basin there are 23 segments identified as Water Quality Limited and 46 segments identified as Effluent Limited (See EXHIBITS 4.1t and 4.2m).

One other important facet of the segmentation process as it relates to the main stem is that the entire segment is designated as Water Quality Limited if treatment in excess of secondary is required to maintain water quality standards at any point on the main stem in that segment. Otherwise, the entire segment is designated as Effluent Limited. Reaches on tributaries requiring a greater than secondary treatment are designated as Water Quality Limited sub-reaches or sections.

METHOD FOR FORMULATION OF SEGMENT PRIORITIES

The following is the procedure for assigning priority values to each stream segment in the State of Kentucky. The priority assigned to a segment is an important factor in allocating financial resources, conducting water quality monitoring, conducting special studies and in taking abatement actions. The priority ranking is required by CFR 130.41 to reflect the following:

(1) Severity of pollution problems;

(2) Population affected;

(3) Need to preserve high quality waters;

(4) National priorities; and,

(5) Factors identified by the state.

OBJECTIVES

The primary objective of the procedure is to yield a systematic means of comparing segments in different locations on a common basis, to produce a priority list and to guide management decisions. The process should be as objective and quantifiable as possible, and should be reproducible on the basis of the data available. Since the segment priority is a key factor in the allocation of federal funds for abatement activities, it is important that the process be defensible and understandable to the public.

The following Segment Priority Formula was developed by the hydrology committee of this River Basin Planning effort together with representatives from EPA.

$$\text{Priority} = \frac{P}{1{,}000} + (\text{BOD-5+SS+NH-3+PO-4+Metals}) + \text{T+NP}$$

Each factor of the formula is explained as follows:

1. Population Affected = $\frac{P}{1{,}000}$

People are affected by water pollution in at least two ways. (1) Pollution may reduce the economic, recreation and aesthetic values of the water to persons who might otherwise gain or benefit from clean water; (2) People will be required to pay, either directly or indirectly for pollution control. Therefore, it is reasonable to include the population in the computation of the segment priority formula.

2. Severity of Pollution = (BOD-5+SS+NH-3+PO-4+Metals)

The severity of pollution formula is comprised of the following factors including: 5-day Biochemical

Oxygen Demand (BOD-5) which effects the oxygen resources of the stream; Suspended Solids (SS), the sedimentation load in the stream which may form a benthic demand; Ammonia and Phosphates (NH-3 + PO-4), factors attributable to enrichment of the water; and, Metals which cause toxic effects. Each factor is expressed in the equation as the difference between the most restrictive requirement and the amount discharged in pounds per day. To determine the most restrictive requirement, three informational sources must be examined: (1) The definition of secondary waste treatment, which is basically 30mg/1 BOD-5 and 30mg/1 of suspended solids supplemented by an ammonia nitrogen limitation of 4mg/1 in the receiving stream; (2) The NPDES permit which contains specific requirements regarding BOD-5 and suspended solids and in some cases ammonia nitrogen; and, (3) The waste load allocation from the "Kentucky Waste Load Allocation Model" developed by the University of Kentucky and the University of Louisville. The metals parameter in the priority formula applies to industrial discharges only and is computed as the difference between the wastewater characteristics and best practical treatment (BPT) or NPDES permit limitations.

3. Special Impact - Thermal = T

In addition to the strength factors described under severity of pollution, cooling water effects are included in the segment priority formula using degrees F. above allowable temperature standards, times the flow in million gallons per day.

4. Special Impact - Non-point Sources = NP

The non-point source factor is a term which permits the addition of 100 points or less where significant non-point sources occur. The term "significant" is to be applied with judgment, using the following criteria:

a. Acid mine drainage will be considered significant when the stream is continuously impregnated with acid mine drainage to the extent that the pH is depressed below 6.0 at least 50 percent of the time.

b. Strip mining is considered as having a significant impact if the present control techniques utilizing sedimentation basins is not sufficient to prevent a substantial increase in suspended solids in the main stem of the river.

c. Combined sewers are considered as having a significant effect when the yearly average combined wastewater overflow equals at least the treated effluent flow.

d. Surface run-off from urban areas is considered significant when the population is equal to or greater than 10,000.

It should be noted that a maximum of 100 points is allowable regardless of the number of non-point sources judged to be significant in the segment.

The Segment Priorities have been computed for each of the 59 segments comprising the Kentucky River Basin and are tabulated in EXHIBIT 4.1t and shown graphically in EXHIBIT 4.3m.

SIGNIFICANT MUNICIPAL DISCHARGERS

Data relative to significant municipal dischargers has been tabulated on EXHIBIT 4.3t and shown graphically on EXHIBIT 4.4m. Descriptive information on this category of dischargers is contained in the following paragraphs.

Method for Significant Discharge Designation

A municipal discharger, is defined as a publicly owned facility eligible for state and federal financial assistance under the terms of Public Law 92-500. All publicly owned facilities have been termed significant for this planning effort.

Significant municipal dischargers are further delineated into two categories: major dischargers and principal dischargers. Major significant municipal dischargers are those capable of producing an effluent in excess of 1 MGD. Principal significant municipal dischargers are those having discharge capacities less than 1 MGD.

In the Kentucky River Basin there are 7 major significant municipal dischargers and 23 principal significant municipal dischargers. These dischargers are tabulated in EXHIBIT 4.4t and shown graphically on EXHIBIT 4.5m.

Method for Formulation of Abatement Priority

The formula for abatement priority was developed cooperatively by personnel in the Division of Water and the Federal Environmental Protection Agency using the following information:

(1) the segment priority (negating metals, thermal pollution, and non-point sources)

(2) the national interest

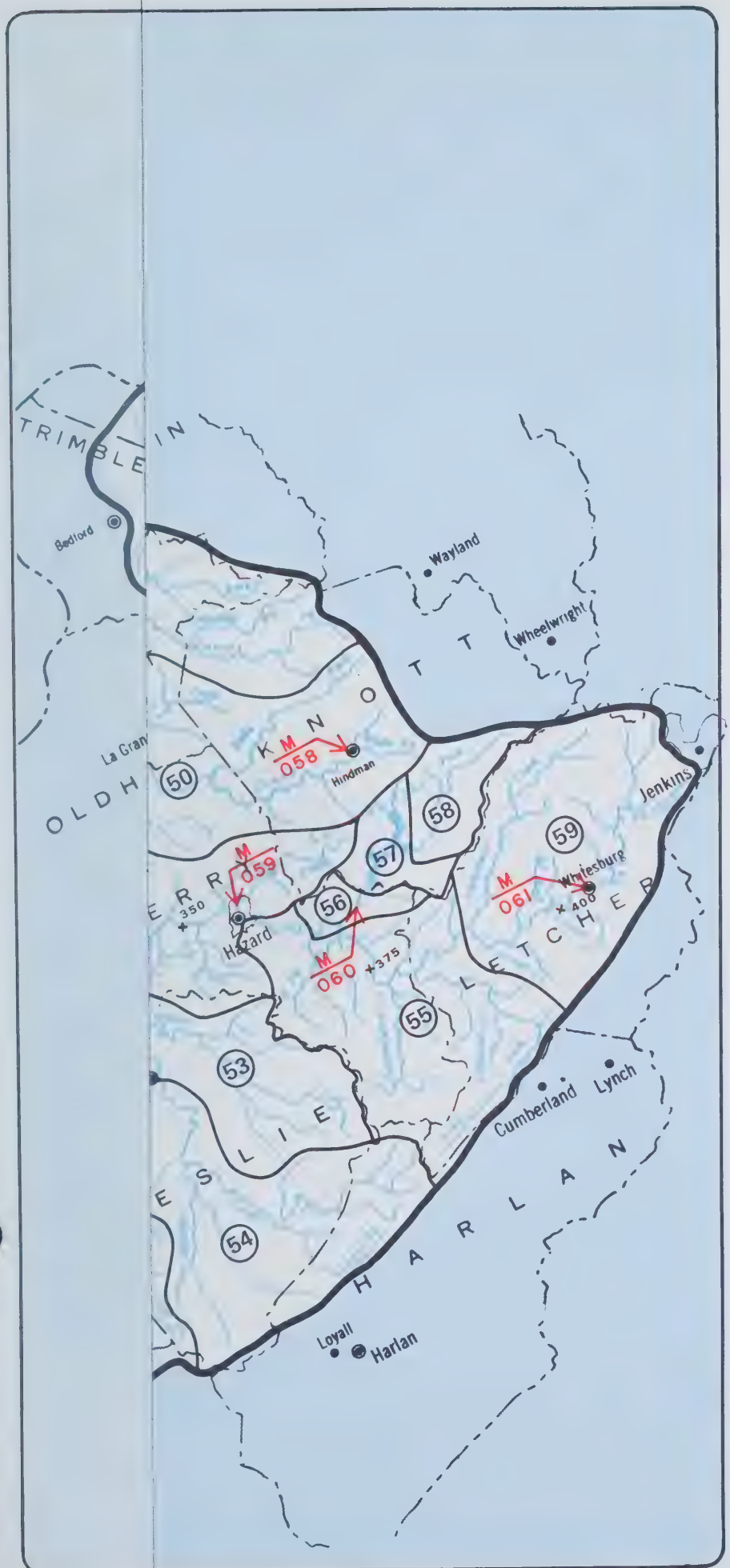
(3) the "needs" survey

(4) status of 201 Facilities Planning.

The total estimated cost of a project within a given segment is used as the basis for assigning fractional proportions of the total cost to items 1 through 5 which follows. The fractional portion of the total cost applicable to each of the items 1 through 5 is then multiplied by the factor listed in the adjacent column of 1 through 5. The proportion of the total cost for each item and the factor is multiplied by the segment priority to obtain a numerical sub-total for each of the appropriate items. The accumulated total for the five items represents the Construction Abatement Priority for the segment.

Exhibit 4. 3t - Significant Municipal Discharges

Discharge Name	Location		Receiving Water	Water Quality Violation	1975 Priority Abatement	NPDES Permit		
	County	Segment				Number	Expir. Date	Compliance Schedule
Carrollton STP	Carroll	435.6 - 0.0 4.0	Kentucky River (0.5)	DO, NH3-N	671 Ca	Ky. 0020256	6/30/77	6/30/77
Williamstown STP	Grant	10.97- 34.6- 0.0/	Stream Mill Branch (2.3)	DO, NH3-N	44 Ca	Ky. 0021008	6/30/77	6/30/77
Owenton STP	Owen	10.97- 38.8- 0.0/	Stevens Cr. (20.8)	DO, NH3-N	261 Ca	*	*	*
New Castle STP	Henry	31.0 - 0.0/	Town Creek (.3.4)	DO, NH3-N	885 Ca	*	*	*
Georgetown STP	Scott	51.9 - 0.0/ 17.8	North Elkhorn Creek (50.8)	DO, NH3-N	2112 Ca	Ky. 0020150	6/30/77	6/30/77
Midway STP	Woodford	51.9 - 0.0/ 17.8	Lee's Branch (16.3)	DO, NH3-N	196 Ca	*	*	*
Lexington STP	Fayette	51.9 - 0.0/ 17.8	Town Branch (10.3)	DO, NH3-N	7781 Aa	Ky. 0021491	6/30/77	6/30/77
Frankfort STP	Franklin	65.0 / 82.5	Kentucky River (65.4)	DO, NH3-N	5779 Ba	Ky. 0022861	6/30/77	6/30/77
Versailles STP	Woodford	65.0 / 82.5	Glenns Creek (12.5)	DO, NH3-N	240 Ca	Ky. 0020621	6/30/77	6/30/77
Danville STP	Boyle	118.2 - 26.2- 0.0/	Clarks Run (8.1)	DO, NH3-N	2109 Ba	Ky. 0022381	6/30/77	6/30/77
Lancaster STP	Garrard	118.2 - 26.2/ 51.1	White Oak Creek (2.7)	DO, NH3-N	392 Ca	Ky. 0020974	6/30/77	6/30/77
Stanford STP	Lincoln	118.2 - 51.1	Logan Creek (2.8)	DO, NH3-N	200 Ca	*	*	*
Nicholasville STP	Jessamine	117.0-139.9- 0.0/	Town Fork (5.3)	DO, NH3-N	458 Ca	Ky. 0020036	6/30/77	6/30/77
Lexington STP #1	Fayette	135.3 - 0.0/	West Hickman Creek (31.3)	DO, NH3-N	235 Aa	Ky. 0021504	6/30/77	6/30/77
Berea STP	Madison	146.0 - 0.0/	Walnut Meadow Creek (4.0)	DO, NH3-N	662 Ca	Ky. 0023523	6/30/77	6/30/77
Berea STP	Madison	150.3 - 0.0/	Silver Creek (37.7)	DO, NH3-N	398 Ca	Ky. 0025515	6/30/77	6/30/77
Richmond STP	Madison	158.1 - 0.0/	Tate Creek (10.9)	DO, NH3-N	672 Ba	Ky. 0022853	6/30/77	6/30/77



KENTUCKY RIVER BASIN

EXHIBIT 4.5m

SIGNIFICANT MUNICIPAL DISCHARGERS

LEGEND

- ⊢ 5 — LOCK AND DAM NUMBER
- \+ 50 — RIVER MILE
- (16) — SEGMENT NUMBER

MUNICIPAL DISCHARGE

- M 100 — MAJOR (1 MGD and over)
- M 100 — PRINCIPAL (Less than 1 MGD)

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

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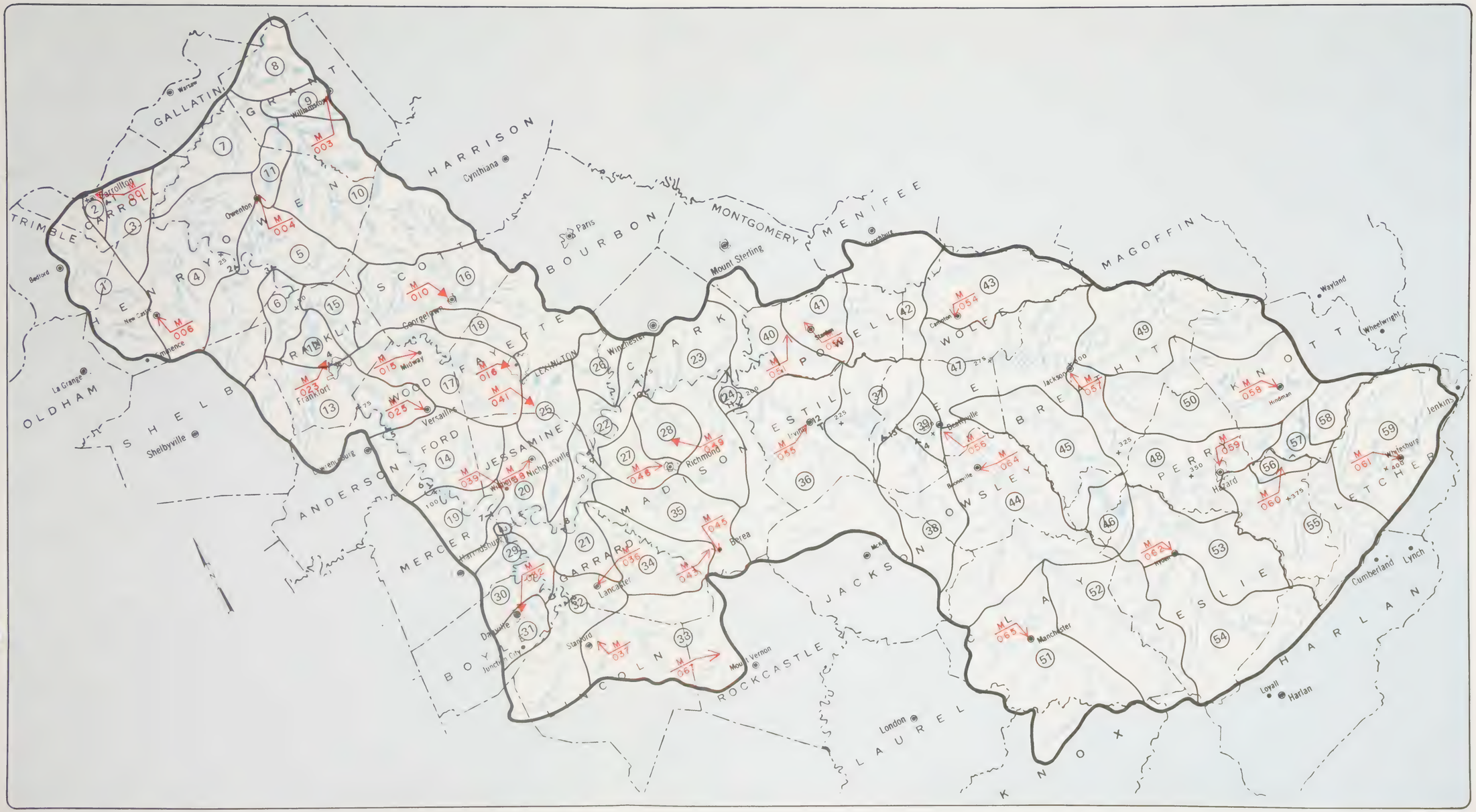

KENTUCKY RIVER BASIN

EXHIBIT 4.5m

SIGNIFICANT MUNICIPAL DISCHARGERS

LEGEND

- 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- (16) SEGMENT NUMBER

MUNICIPAL DISCHARGE

- M 100 MAJOR (1 MGD and over)
- M 100 PRINCIPAL (Less than 1 MGD)

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U S Geological Survey

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Exhibit 4.3t - Significant Municipal Dischargers

Discharge Name	Location		Receiving Water	Water Quality Violation	1975 Priority Abatement	NPDES Permit		
	County	Segment				Number	Expir. Date	Compliance Schedule
Richmond STP Otter Creek	Madison	177.3- 0.0/	Tribble Br. (3.0)	DO, NH3-N	1160 Ba	Ky. 0022845	6/30/77	6/30/77
Clay City STP	Powell	190.8- 0.0/ 21.4	UT-Red River (20.2-0.4)	DO, NH3-N	8 Ca	Ky. 0025119	6/30/77	6/30/77
Stanton STP	Powell	190.8- 21.4/ 41.1	Red River (30.6)	DO, NH3-N	4 Ca	*	*	*
Campton STP	Wolfe	190.8- 41.1/ 59.5	Swift Camp Creek (11.20)	DO, NH3-N	87 Ca	Ky. 0026069	6/30/77	6/30/77
Irvine STP	Estill	201.0/220.9	Kentucky River (218.1)	DO, NH3-N	20 Ca	Ky. 0025909	6/30/77	6/30/77
Beattyville STP	Lee	254.8/300.1	Kentucky River (255.5)	DO, NH3-N	10 Ca	Ky. 0021121	6/30/77	6/30/77
Jackson STP	Breathitt	254.8/300.1	Kentucky River (300.1)	DO, NH3-N	159 Ca	Ky. 0021288	6/30/77	6/30/77
Hindman STP	Knott	313.7- 0.0/	Troublesome Creek (42.4)	DO, NH3-N	289 Ca	*	*	*
Hazard STP	Perry	300.1/361.0	N.Fk.Kentucky River (357.8)	DO, NH3-N	510 Ca	Ky. 0020079	6/30/77	6/30/77
Vicco STP	Perry	367.8- 0.0/ 8.78	Carr Fork (6.22)	DO, NH3-N	0 Ca	*	*	*
Whitesburg	Letcher	388.0/	N.Fk.Kentucky River (403.6)	DO, NH3-N	81 Ca	Ky. 0023183	6/30/77	6/30/77
Hyden STP	Leslie	258.6- 67.1/	M.Fk.Kentucky River (72.7)	DO, NH3-N	60 Ca	Ky. 0021245	6/30/77	6/30/77
Booneville STP	Owsley	254.8- 0.0/ 45.1	S.Fk.Kentucky River (12.0)	DO, NH3-N	19 Ca	*	*	*
Manchester STP	Clay	254.8- 45.1- 0.0/	Goose Creek (66.1)	DO, NH3-N	668 Ca	*	*	*
Wilmore STP	Jessamine	117.0-139.9- 0.0/	Town Branch	DO, NH3-N	168 Ca	*	*	*
Brodhead	Rockcastle	118.2- 51.1/	Dix River	DO, NH3-N	121 Ca	*	*	*

* No permit has been issued by the date of this report.

NEEDS	MULTIPLIER
1. Treatment	Factor
T1	2.0
T2	2.5
T3	3.5
T4	4.5
T5	6.0
2. Inflow/infiltration	1.5
3. Interceptor Sewers	2.0
4. Collection Sewers	1.0
5. Combined Sewers	0.5

Subsequent to obtaining the priority number, a capital letter, A, B, or C is assigned based on population of the community as follows:

"A" - for a community in a SMSA

"B" - for a community not in a SMSA and having a population in excess of 10,000

"C" - for a community not in a SMSA and having a population less than 10,000

An additional lower case letter, a, b, or c is assigned for the purpose of designating the status of 201 Facilities Planning as follows:

"a" - Step No. 1 initiation

"b" - Step No. 2 initiation

"c" - Step No. 2 completion

The following is an example of the calculation for determining the Construction Abatement Priority number for a town not located in a SMSA having a population of 50,000, requiring a treatment level of T2A, and having a 201 Facilities Plan underway.

(1)	Treatment level required T2	cost $	200,000
(2)	Inflow/infiltration required	cost	150,000
(3)	Interceptors required	cost	50,000
(4)	Collection Sewers required	cost	300,000
(5)	Combined sewers separation	cost	300,000
Total Cost			$1,000,000

Fractions of the total cost for each of the above 5 items are as follows:

(1) $\frac{200,000}{1,000,000} = 0.20$

(2) $\frac{150,000}{1,000,000} = 0.15$

(3) $\frac{50,000}{1,000,000} = 0.05$

(4) $\frac{300,000}{1,000,000} = 0.30$

(5) $\frac{300,000}{1,000,000} = 0.30$

Exhibit 4.5t Example Calculation of Construction Abatement Priority Number

	Proportional Cost	Multiplying Factor	Segment Priority	Abatement Sub-total
(1)	0.20	2.5	400	200
(2)	0.15	1.5	400	90
(3)	0.05	2.0	400	40
(4)	0.30	1.0	400	120
(5)	0.30	0.5	400	70
Construction Abatement Priority				520

Based on the above example, the Abatement Priority designation is 520-Ba.

Owner of Discharging Facility

EXHIBIT 4.3t indicates the ownership of the significant municipal dischargers.

Geographic Location of Dischargers

Geographic location of each significant municipal discharger is shown on EXHIBIT 4.4m.

Segment Receiving Discharge

EXHIBIT 4.4m shows segments receiving the discharge. EXHIBITS B-1m through B-8m show segment analysis in greater detail.

1975 Abatement Priority and NPDES Permit

The 1975 Abatement Priority and the NPDES permit information are set forth in EXHIBIT 4.3t.

SIGNIFICANT DOMESTIC DISCHARGES

Data relative to significant domestic discharges have been tabulated on EXHIBIT 4.6t and the location shown graphically on EXHIBIT 4.7m. Descriptive information on this category of dischargers is contained in the following paragraphs.

Method For Significant Discharge Designation

Significant domestic discharges differ with respect to significant municipal discharges in that they are privately owned or semi-publicly owned and are not eligible for state and federal financial assistance for construction and upgrading.

An additional criterion for designation of "significant" discharge under this category is that the facility being evaluated must have a design capacity equal to or greater than 50,000 gallons per day.

Significant dischargers are further delineated between major dischargers (over 1 MGD effluent flow), and principal dischargers (less than 1 MGD effluent flow). There are no major significant domestic dischargers in the Kentucky River Basin.

Exhibit 4.6t

Significant Domestic Dischargers

Discharge Name	Location		Receiving Water	Water Quality Violation	NPDES Permit			
	County	Segment			Owner	Number	Expir. Date	Compliance Schedule
General Butler State Park	Carroll	4.0 / 10.97	UT-Kentucky R. (0.1)	DO BOD, NH3	Ky.Dept. of Parks	*	*	6/30/77
Delaplain Motels	Scott	10.97/ 34.6	Little Eagle Creek (12.6)	DO BOD, NH3	Triport Ind. Park	*	*	6/30/77
Highland Subdivision	Scott	51.9 - 45.3-0.0	Cane Run (14.10)	DO BOD, NH3	Highland Subdivision	*	*	6/30/77
South Elkhorn Service Co.	Fayette	51.9 - 17.8-0.0	South Elkhorn Creek (50.8)	DO BOD, NH3	South Elkhorn Service Co.	*	*	6/30/77
Federal Corr. Institution	Fayette	51.9 - 17.8-0.0	Steeles Run (5.9)	DO BOD, NH3	U.S. Government	*	*	6/30/77
Monticello Ests. Sub.STP	Fayette	51.9 - 17.8-0.0	South Elkhorn Creek (48.9)	DO BOD, NH3	Monticello Ests. Sub.	*	*	6/30/77
Keenland Race Course	Fayette	51.9 - 17.8-0.0	Manchester Branch (2.0)	DO BOD, NH3	Keenland Race Course	*	*	6/30/77
Kentucky State Hospital-East	Mercer	118.2 - 3.0/ 26.2	Herrington Lake (16.6)	DO BOD, NH3	Commonwealth of Kentucky	*	*	6/30/77
Bluegrass Disposal Corp.	Jessamine	135.3 - 0.0	UT-Hickman Cr.(25.8-1.2)	DO BOD, NH3	Bluegrass Disposal Corp.	*	*	6/30/77
Brooklyn Subd. STP	Madison	150.3 - 0.0	UT-Taylor Fk. (10.9-5.1)	DO BOD, NH3	B & H Development Co.	*	*	6/30/77
Blue Sky Development Co.	Fayette	170.6 - 0.0	UT-Baughman Fk.(0.55-2.0)	DO BOD, NH3	Blue Sky, Inc.	*	*	6/30/77
JFG Enterprises	Fayette	170.6 - 0.0	UT-Baughman Fk.(2.75-5.5)	DO BOD, NH3	JFG Enterprises	*	*	6/30/77

* No permit has been issued as of date of this report

The rationale for exclusion of lesser flows is based on field experience with respect to their impact on water quality, geographical location and proposed State Regulation 401 KAR 5:005.

Domestic treatment plants discharging less than 50,000 gallons per day would be equivalent to a population of 500 people or less. Assuming 80-85 percent removal under present conditions, less than 20 pounds of BOD-5 would be discharged, an insignificant amount compared with the larger facilities that produce a profound effect upon water quality. Background BOD-5 will often be in excess of that emitted by the smaller plants.

With respect to geographical location, many of the smaller wastewater treatment facilities (50,000 gpd or less) are located near metropolitan or urban areas that will eventually develop comprehensive wastewater collection systems and in the process will cause elimination of the smaller treatment facility.

Regulation 401 KAR 5:005 proposed by the Kentucky Department of Natural Resources, Bureau of Environmental Quality, Division of Water Quality requires facilities having a design capacity of 50,000 gallons per day or more to submit an annual report. This appears to be a sensible approach and one that can be supported on a practical basis.

Owner of Discharging Facility

EXHIBIT 4.6t indicates ownership of significant domestic dischargers and locations are shown graphically on EXHIBIT 4.7m.

Geographical Location of Discharge Outfall

EXHIBIT 4.6t indicates the discharge location by river mile. Additional specific information may be found in Appendix B - Segment Analysis.

Segment Receiving Discharge

EXHIBIT 4.6t indicates the stream segment receiving the discharge. Specific information may be found in Appendix B - Segment Analysis.

1975 Abatement Priority and NPDES Permit

The 1975 Abatement Priority and NPDES permit number are set forth in EXHIBIT 4.6t. It should be noted that not all of the non-municipal NPDES permits have been issued as of this date. It is anticipated that the Federal Environmental Protection Agency will complete the task of permit issuance in the near future. Target dates for completion of this task are not available at this time; however, permits already issued and those yet to be issued will only be effective until July 1, 1977. At that time, all permits will be reissued to reflect the changes in treatment requirements set forth in Section 301(b)(1)(A) of P.L. 92-500.

SIGNIFICANT INDUSTRIAL DISCHARGERS

Data relative to significant industrial discharges has been tabulated on EXHIBIT 4.8t and their locations shown graphically on EXHIBIT 4.7m. Additional descriptive information follows:

Method for Significant Discharge Designation

An industrial discharge has been defined as privately owned wastewater facilities for treatment of industrial wastes discharging into streams of the Commonwealth and not into a municipal wastewater collection system. Such facilities are not eligible for state or federal grants-in-aid of construction.

A "significant" industrial discharger is one discharging 50,000 gallons or more per day. Additionally, any industrial discharger disposing of toxic materials such as heavy metals through means of the discharged effluent has also been termed "significant".

Significant industrial dischargers are further delineated into two subdivisions, major dischargers and principle dischargers.

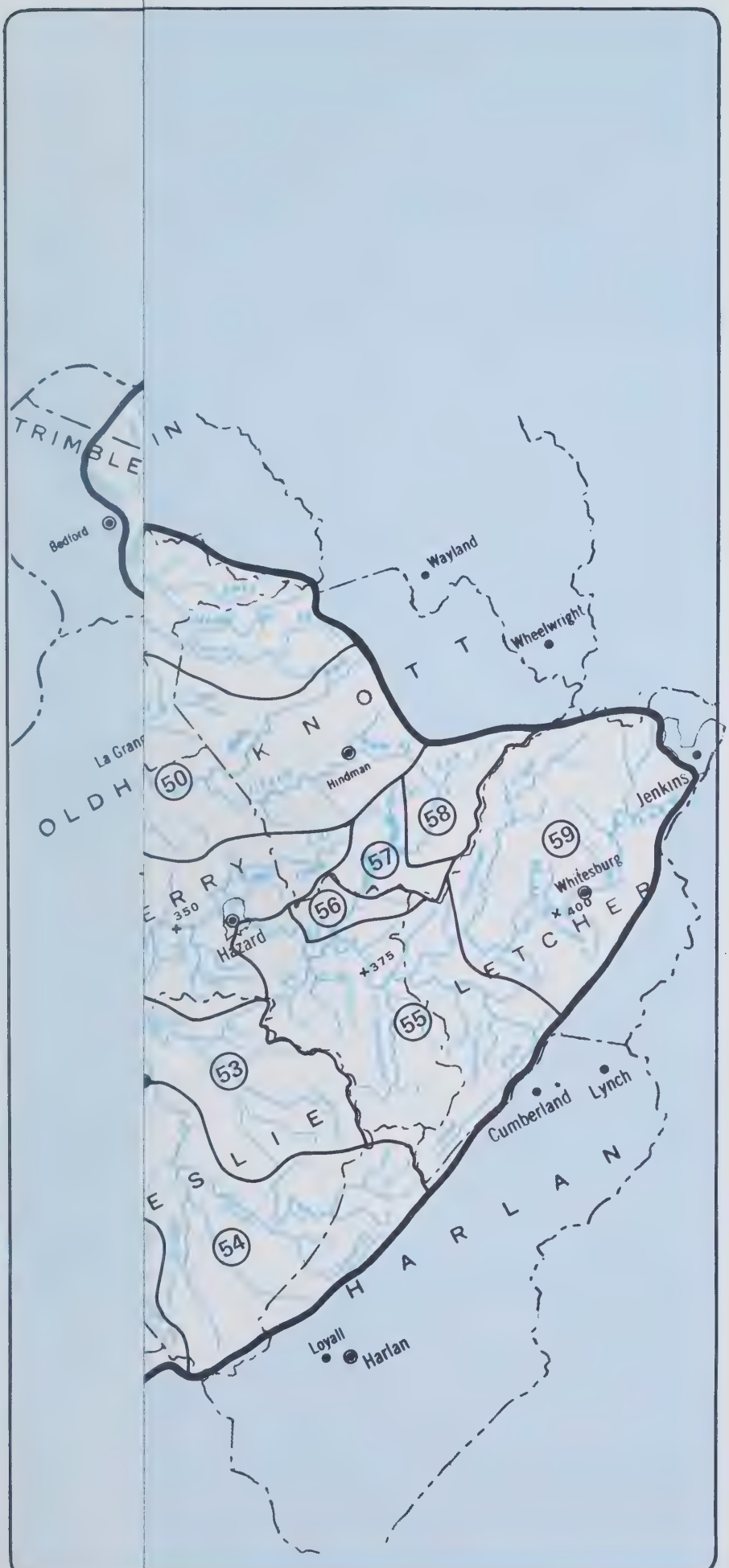
Major significant industrial dischargers are those capable of providing an effluent volume in excess of 1 M.G.D.

Principle significant dischargers are those having capacities less than 1 M.G.D.

Exhibit 4.8t Significant Industrial Dischargers

Discharge Name	Location		Receiving Water	Water Quality Violation	Prin Sic. Code	NPDES Permit			
	County	Segment				Owner	Number	Expir. Date	Compliance Schedule
Geoghagan & Mathis	Henry	10.97/31.0	Kentucky River (30.1)	SS	32	Geoghagan & Mathis	Ky.0001511		6/30/77
Central Screw	Franklin	59.9 - 0.0/ 17.8	Elkhorn Creek (16.8)	-	34	Central Screw Co.	Ky.0003301		6/30/77
Old Grand Dad	Franklin	59.9 - 0.0 17.8	Elkhorn Creek (16.9)	BOD	20	Old Grand Dad, Inc.	Ky.0001252		6/30/77
I. B. M.	Fayette	51.9 -45.3- 0.0/	Cane Run (12.90)	-	38	I. B. M.			6/30/77
Vulcan Materials	Fayette	51.9 -45.3- 0.0/	Cane Run (11.50)	SS	32	Vulcan Materials	Ky.0002691		6/30/77
U.S. Army Depot	Fayette	51.9 -17.8- 0.0/	North Elkhorn (82.8)	-		U.S. Army	Ky.0001139		6/30/77
General Electric	Fayette	31.9 -17.8- 0.0/	Shannon Creek (1.1)	-	32	General Elec. Co.			6/30/77
Central Rock Company	Fayette	51.9 -17.8- 0.0/	Town Branch (10.95)	SS	32	Central Rock Co.			6/30/77

* Permit not issued as of date of this report.



KENTUCKY RIVER BASIN

EXHIBIT 4.7m

SIGNIFICANT NON—MUNICIPAL DISCHARGERS

LEGEND

- 5 LOCK AND DAM NUMBER
- 50 RIVER MILE
- (16) SEGMENT NUMBER

DOMESTIC DISCHARGER

- D 100 — MAJOR (1 MGD and over)
- D 100 — PRINCIPAL (Less than 1 MGD)

INDUSTRIAL DISCHARGER

- I 100 — MAJOR (1 MGD and over)
- I 100 — PRINCIPAL (Less than 1 MGD)

COOLING WATER DISCHARGER

- C 100 — MAJOR (1 MGD and over)
- C 100 — PRINCIPAL (Less than 1 MGD)

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

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KENTUCKY RIVER BASIN

EXHIBIT 4.7m

SIGNIFICANT NON—MUNICIPAL DISCHARGERS

LEGEND

- 5 LOCK AND DAM NUMBER
- 50 RIVER MILE
- (16) SEGMENT NUMBER

DOMESTIC DISCHARGER

- MAJOR (1 MGD and over)
- PRINCIPAL (Less than 1 MGD)

INDUSTRIAL DISCHARGER

- MAJOR (1 MGD and over)
- PRINCIPAL (Less than 1 MGD)

COOLING WATER DISCHARGER

- MAJOR (1 MGD and over)
- PRINCIPAL (Less than 1 MGD)

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U S Geological Survey

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Exhibit 4.8t

Significant Industrial Dischargers

Discharge Name	Location		Receiving Water	Water Quality Violation	Prin Sic. Code	NPDES Permit			
	County	Segment				Owner	Number	Expir. Date	Compliance Schedule
American Can Company	Fayette	51.9 -17.8-0.0/	Town Branch (10.55)	-	26	American Can Co.			6/30/77
Schenley Distilleries	Franklin	65.0 /82.5	Penitentiary Run (.25)	BOD	20	Schenley Distill.			6/30/77
National Distillers	Woodford	65.0 /82.5	Glenns Creek (0.5)	BOD	20	National Distill.	Ky.0001236 Ky.0001244		6/30/77
Kentucky Utilities (Tyrone)	Anderson	82.5 /96.2	Kentucky River (84.6)	-		Kentucky Utilities			6/30/77
Austin-Nichols	Anderson	82.5 /96.2	Kentucky River (83.75)	BOD	20	Austin-Nichols	Ky.0001643		6/30/77
Universal Button	Anderson	82.5 /96.2	Cedar Brook (4.0)	SS	39	Textron Inc.			6/30/77
Kentucky Stone Company	Anderson	82.5 /96.2	Kentucky River (84.35)	SS	32	Kentucky Stone Co.	Ky.0002551		6/30/77
Corning Glass	Boyle	118.2 /26.2-0.0/	Clarks Run (9.0)	-	32	Corning Gls.Wks.	Ky.0002607		6/30/77
Whirlpool Corp.	Boyle	118.2 -26.2 0.0/	Clarks Run (10.2)	-	35	Whirpool Corp.	*		6/30/77
Caldwell Stone	Boyle	118.2 - 26.2	Clarks Run (5.7)	SS	32	Caldwell Stone	Ky.0001198		6/30/77
Boonesboro Quarry	Fayette	157.5 -176.4	Kentucky River (174.7)	SS	32	Boonesboro Quarry	Ky.0001058		6/30/77
East Kentucky Recc.	Madison	157.5 -176.4	Kentucky River (176.4)	-		E. Kentucky Recc.			6/30/77
Tennessee Gas Transmission Co.	Powell	190.8 - 0.0-21.4	UT-Lulbegrud Cr.(9.3-0.6)	-	29	Tenn. Gas Trans.Co.	Ky.0001481		6/30/77
Bluegrass Army Depot	Madison	176.4 /190.8	Muddy Creek (22.8-5.0)	BOD DO	-	U.S. Government	-	-	-

In the Kentucky River Basin, there are two major significant dischargers, Kentucky Utilities and East Kentucky R.E.C.C., and thirteen principle industrial dischargers.

All industrial dischargers are tabulated on EXHIBIT 4.7t and the significant industrial dischargers are located graphically on EXHIBIT 4.6m.

Owner of Discharging Facility

EXHIBIT 4.7t tabulates ownership of the industrial discharger.

Geographic Location of Discharge

The geographic location of each industrial discharger is listed on EXHIBIT 4.7t and graphically shown on EXHIBIT 4.6m.

Segment Receiving Discharge

EXHIBIT 4.7t sets forth the segment receiving the discharge and the location is graphically shown on EXHIBIT 4.6m.

1975 Abatement Priority and NPDES Permit

The compliance schedule, NPDES Permit Number, SIC Code, and Water Quality Violations are also shown on EXHIBIT 4.7t. Some NPDES permits have been omitted for the lack of data.

SIGNIFICANT NON-POINT SOURCES

Agricultural, silvicultural, construction and mining activities, and urban runoff contribute pollutant substances to surface and groundwaters. These activities are considered non-point sources because of their diffuse nature. A major pollutant for each is sediment, the soil materials which erode from the surface of the land and are transported to streams and reservoirs by runoff water. In addition, acid drainage from coal mining activities is an important non-point source of pollution in the Kentucky River Basin.

Erosion and the resulting sediment load in streams is an important problem throughout the basin. In the Headwater Section, sediment loads from mining activity and, to a lesser extent, logging operations have an impact on streams in the small watersheds. In the Bluegrass Region, sediment load in streams is due primarily to agricultural operations which are more widespread over the region.

Evaluating the significance of non-point sources is more complex than for point sources because they normally are spread over a larger area and involve numerous variables and interactions. Specific data on non-point sources generally are not available to assist in determining the significance of the pollutant on stream quality. A limited amount of information is available on watersheds for which lakes or ponds have been planned by the Corps of Engineers or Soil Conservation Service. Storet data were available for design studies conducted by the Corps of Engineers for Eagle Creek Lake, Buckhorn Lake, Booneville Lake, Red River Lake and Carr Fork Lake.

Suspended sediment in a stream can fluctuate tremendously during storm periods; therefore, it is not normally included as part of the standard water quality testing by the U.S. Geological Survey at its monitoring stations. Within the Kentucky River Basin, the only USGS station at which suspended sediment concentration has been measured on a regular basis is Lock 4 at Frankfort (Station 03287500). The extremes for the period of record (1952-73) are shown in the following table:

Lock 4, Frankfort		
	Maximum Daily	Minimum Daily
Sediment Concentration	2,420 mg/1 (Jan.31, 1956)	1 mg/1 *
Sediment Discharge	420,000 tons (Feb.28, 1967)	0.53 ton (Nov.17,1952)

* Value reported for many days during 1952-56, 1962, and 1964.

Source: Water Resource Data for Kentucky, U.S. Geological Survey, 1972-73

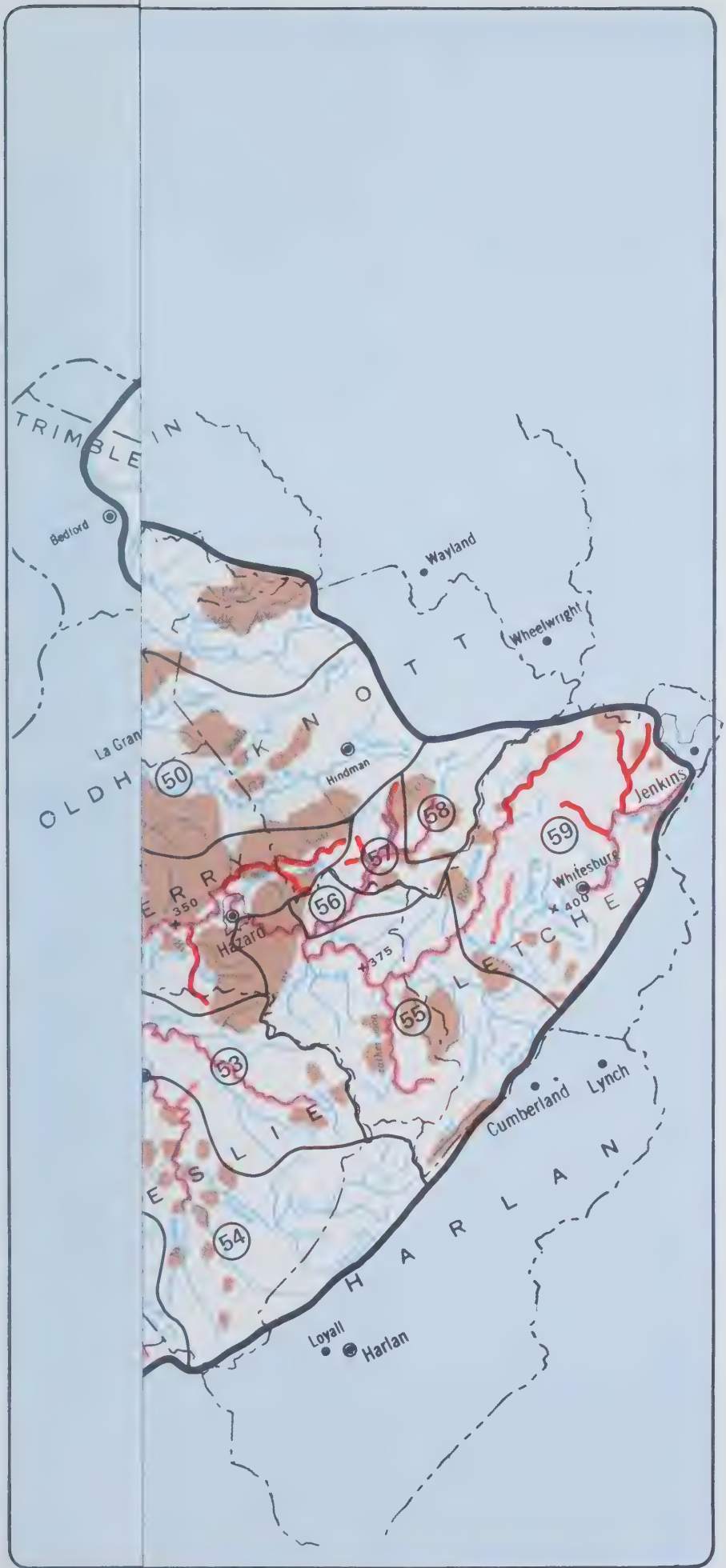
Suspended sediment discharge measurement was initiated in 1973 by the USGS at Lock 2 on the Kentucky River at Lockport. Data for a few selected days is presented in the 1972-73 annual report (70).

About the only additional data available on sediment runoff for the Kentucky River Basin is reported in several articles on erosion and sedimentation from strip-mining operations by Willie R. Curtis, Hydrologist with the U.S. Forest Service at Berea, Kentucky, (14, 15, 16, 18). Studies were conducted in two small watersheds in Breathitt County (17); Leatherwood Creek, a tributary of South Fork Quicksand Creek, and Bear Branch, a tributary of Buckhorn Creek. Suspended sediment concentrations as high as 46,400 parts per million (ppm) were observed during active mining periods. A corresponding value for a nearby forested watershed was 150 ppm.

The Corps of Engineers is currently monitoring suspended sediment load in Carr Fork where it enters the recently constructed Carr Fork Reservoir. The sampling period was initiated in February 1974, and results have not been published to date.

The relative significance of non-point sources used in the Segment Priority Formula of this plan is defined in the first part of this chapter. Briefly, it is a judgment factor which allows up to 100 points for acid drainage where pH is depressed below pH 6 at least 90% of the time or pH 5 at least 50% of the time; strip mining if sedimentation basins are not controlling sediment runoff; combined sewers when overflow equals treated effluent flow, and surface runoff in larger urban areas.

The following discussion will address non-point sources in general terms first, then focus in on significant non-point sources as defined for the segment priority formula.



KENTUCKY RIVER BASIN

EXHIBIT 4.9m

SIGNIFICANT NON-POINT SOURCES

LEGEND

- ⊢ 5 — LOCK AND DAM NUMBER
- \+ 50 — RIVER MILE
- (16) — SEGMENT NUMBER
- C.S. — COMBINED SEWER AREA
- MINING OR QUARRYING ACTIVITY
- ACID MINE DRAINAGE
  - SIGNIFICANT AFFECT
  - INTERMITTENT AFFECT
- SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

5 0 10 20

GRAPHIC SCALE IN MILES

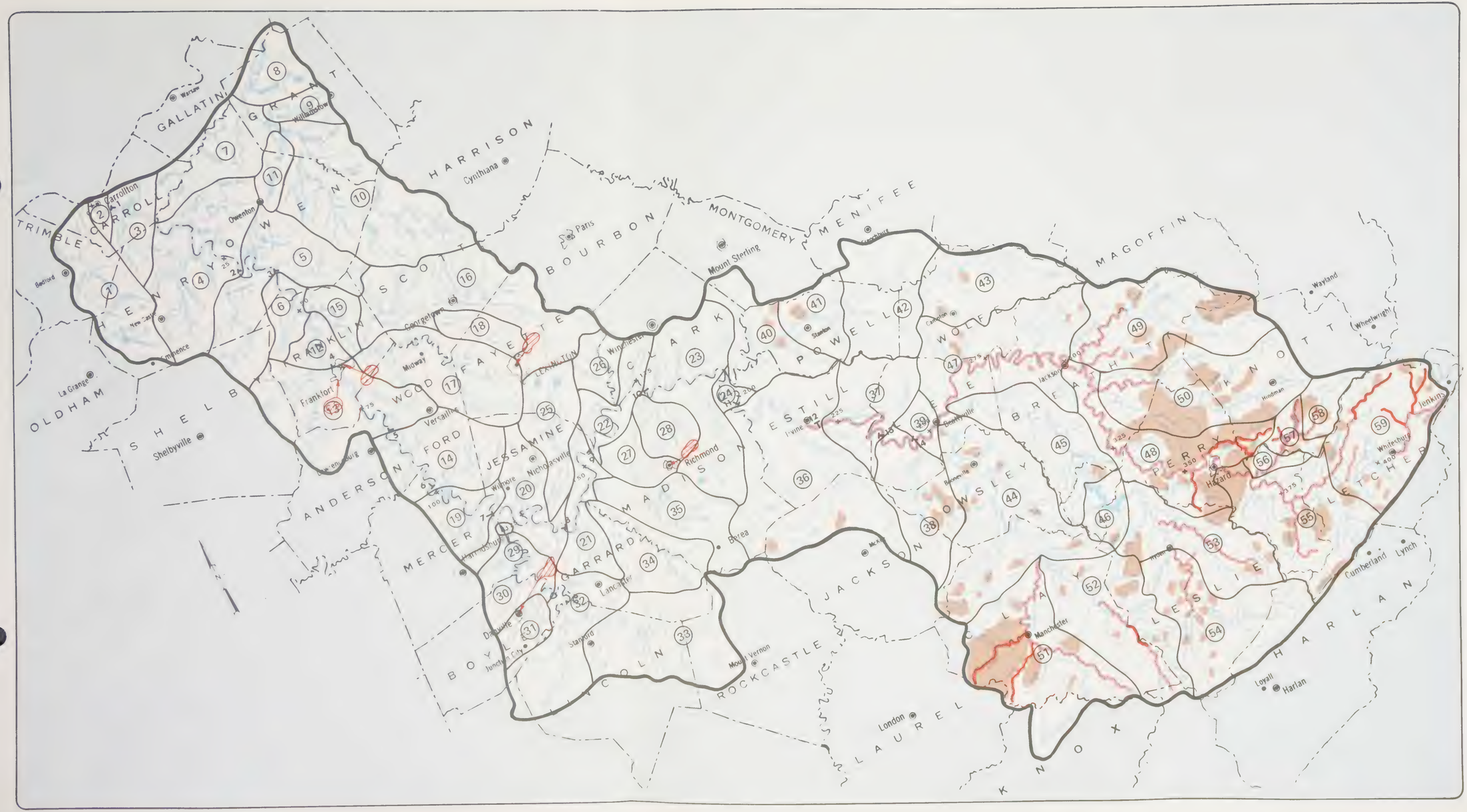
Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Miller, Wihry & Lee
INCORPORATED
Landscape Architects and Engineers
Landward House • 1387 South Fourth Street • Louisville, Kentucky


GALLATIN
GRANT
HARRISON
TRIMBLE
CARROLL
BOONE
KENTON
CAMPBELL
PENDLETON
OWEN
SCOTT
BOURBON
MONTGOMERY
MENIFEE
MAGOFFIN
OLDHAM
SHELBY
FRANKLIN
WOODFORD
FAYETTE
CLARK
POWELL
WOLFE
BREATHITT
KNOTT
ANDERSON
JESSAMINE
MADISON
ESTILL
MORGAN
PERRY
LETCHER
MERCER
BOYLE
GARRARD
ROWAN
MAGOFFIN
JACKSON
LINCOLN
ROCKCASTLE
LAUREL
KNOX
LESLIE
CLAY
HARLAN
BELL
Warsaw
Carrollton
Owenton
Williamstown
Cynthiana
Paris
Mount Sterling
Frankfort
Versailles
Midway
Georgetown
Lexington
Winchester
Richmond
Berea
Irvine
Stanton
Jackson
Hindman
Hazard
Whitesburg
Wayland
Wheelwright
Jenkins
Cumberland
Lynch
Harlan
Loyall
Manchester
London
Mount Vernon
Stanford
Lancaster
Danville
Junction City
Harrodsburg
Nicholasville
Wilmore
Shelbyville
La Grange
Bedford
New Castle
Campton
Beattyville
Booneville
Irvine
Brooksville
Mt. Sterling
Elizabethtown
Louisville
Cincinnati
Ashland
Pikeville
Middlesboro
Somerset
Corbin
Barbourville
Pineville
Williamsburg
Monticello
Columbia
Glasgow
Bowling Green
Hopkinsville
Owensboro
Henderson
Madisonville
Paducah
Murray
Mayfield
Fulton
Union City
Dyersburg
Memphis
Nashville
Clarksville
Evansville
Vincennes
Terre Haute
Indianapolis
Cincinnati
Huntington
Charleston
Beckley
Bluefield
Princeton
Welch
Kingsport
Johnson City
Knoxville
Oak Ridge
Chattanooga
Cleveland
Athens
Sparta
McMinnville
Shelbyville
Murfreesboro
Lebanon
Gallatin
Hartsville
Springfield
Clarksville
Dickson
Columbia
Franklin
Brentwood
Nashville
Gallatin
Hendersonville
Lebanon
Mt. Juliet
Smyrna
La Vergne
Murfreesboro
Shelbyville
Tullahoma
Manchester
Winchester
Sewanee
Monteagle
Jasper
Dunlap
Soddy-Daisy
Hixson
Red Bank
Signal Mountain
Lookout Mountain
Rossville
Fort Oglethorpe
Chickamauga
Ringgold
Dalton
Calhoun
Cartersville
Rome
Summerville
Trion
Lafayette
LaFayette

Agriculture

Potential non-point agricultural sources of surface and groundwater pollution include sediments, nuitrients, pesticides, organic loads and pathogens. Sediment resulting from soil erosion is regarded as the major pollutant that affects water quality. Erosion occurs as a natural geologic process but may be accelerated by man's actions -- including agricultural activities. Agricultural lands, particularly cropland, are large contributers of sediment. On a nationwide basis, it is estimated that cropland is responsible for about 50% of the total sediment yield in inland waterways (47). Sediment carries with it significant quantities of plant nutrients, pesticides, organic and inorganic matter, pathogens and other water pollutants.

Of the 7,071 sq. mi. land area in the Kentucky River Basin, about 47 percent, or 3,322.7 sq. mi. is attributed to agricultural use (See EXHIBIT A6.1t). The gently-rolling limestone soils of the Bluegrass Section are far better suited for agricultural use than are the mountains of the Headwater Section. This is reflected in the following table on land use comparisons for the Bluegrass Region and the Eastern Coal Field Region, where the Headwater Section is located:

Physiographic Region	Land Use			
	Cropland-%	Pasture-%	Forest-%	Other-%
Bluegrass Region	30	45	22	3
Eastern Coal Field Region	8	8	80	4

Source: Kentucky Soil and Water Conservation Needs Inventory, 1970 (36).

In the Kentucky River Basin, approximately 79 percent, or 2,623 sq. mi., of the agricultural land is in the Bluegrass Section, compared with 21 percent, or 700 sq. mi., located in the Headwater Section. Not all of this agricultural land is disturbed by tillage operations each year. Only that portion of the agricultural land that is tilled for crops is of major concern for sediment runoff. It is estimated that in the Bluegrass Section 1,096 sq. mi. of agricultural land is disturbed by tillage annually, while in the Headwater Section about 228 sq. mi. is tilled. Thus about 1,324 sq. mi., or 18 percent, of the total land area in the basin is tilled for agriculture production each year.

Most soils in the Kentucky River Basin have a moderate to high potential sediment runoff under disturbed conditions (See EXHIBIT 3.3t). Soils in the Headwater Section generally have a high potential sediment runoff because of the steep slopes on which they are located. However, because of the relatively small acreage of agricultural land that is tilled (less than 7 percent of the total land area in the Headwater Section), the amount of sediment resulting from the limited agricultural activities in the Headwater Section would be considered insignificant when compared to the sediment load resulting from strip mine activities.

In the Bluegrass Section, approximately 1,096 sq.mi. are disturbed each year for crop production. Sediment runoff from cultivated soils in the karst topography of the Inner Bluegrass region is normally deposited in the lowest area of the sink, and thus does not affect stream quality. Tillage operations in the more rolling topography of the Outer Bluegrass region does affect sediment runoff into streams. The most severe conditions for sediment runoff exist in the Hills of the Bluegrass, where the combination of steep slopes and impervious shale bedrock results in rapid surface runoff. For example, the sediment load in Eagle Creek, located in the Hills of the Bluegrass region, is generally higher than for Elkhorn Creek, which drains the Inner Bluegrass region (32).

Agricultural silt is identified as a non-point source of pollution of Eagle Creek in Exhibit 4.8t based on a listing of fishing streams significantly degraded by pollution in Kentucky Fisheries Bulletin No. 56 (32). Storet data for a sampling station located at the Corps of Engineers proposed Eagle Creek Lake (See EXHIBIT 5.7m) indicate an average of 93 parts per million suspended solids for 9 samples. This data is considered insufficient to fully assess the significance of agricultural runoff in the Eagle Creek watershed.

Although sediment runoff from agricultural lands is recognized as a general problem in the Kentucky River Basin,currently available data are insufficient to quantify the significance of this non-point source of pollution on an individual segment-level basis.

Agricultural feed lots and stock yards are considered non-point sources of pollution. At the present time, there are no known feed lots or stock yards which have a significant effect on stream quality in the Kentucky River Basin.

Silviculture

An established, well-managed forest is generally exceptionally free of erosion and sediment pollution to streams. Productivity can be maintained over the long term with assistance from man, which necessarily includes harvest of trees. A silvicultural cycle includes a relatively long period of growth, which can be essentially free of pollution output, and a relatively short period of harvest and reforestation, which, as a result of disturbances, can be a time of high sediment runoff. In addition, forests disturbed by natural disasters (fire) are highly erodible.

In the Kentucky River Basin, approximately 3,637 sq. mi. of land is in forestland, most of which is located in the Headwater Section. Lumber production in 1973 for counties located in the Headwater Section amounted to about 84 million board feet (51). Timber harvesting is distributed fairly uniformly over the entire area and varies from year to year, so harvesting of timber in managed forests is not considered a significant non-point source of pollution in the basin.

However, clear-cutting operations which precede strip mining activities can result in serious erosion

Exhibit 4.10t

Significant Non-Point Discharges

Non-Point Source	Location		Receiving Water	Water Quality Violation	Compliance Schedule	Recommended Management or Pollution Control Program
	County	Segment				
Agriculture *	Owen Grant	7 & 10	Eagle Creek	Susp. Solids		Conservation Program
Abandoned Mines **	Clay	51	Goose Creek Little Goose Creek Horse Creek	Acid Drainage		Acid Mine Drainage Abatement Program
Abandoned Mines *	Clay	44	Sexton Creek	Acid Drainage		Acid Mine Drainage Abatement Program
Stripmines *	Clay	52	Redbird River	Susp. Solids		Sedimentation Control Program
Stripmines *	Leslie	53	Cutskin Creek	Susp. Solids		Sedimentation Control Program
Abandoned Mines **	Perry	48	Big Creek Lotts Creek	Acid Drainage		Acid Mine Drainage Abatement Program
Abandoned Mines **	Letcher	54	Rockhouse Cr. Millstone Cr.	Acid Drainage		Acid Mine Drainage Abatement Program
Stripmines *	Letcher	55	Leatherwood Creek Lime Fork	Susp. Solids		Sedimentation Control Program
Mining *	Perry	56	Carr Fork	Acid Drainage Sediment Runoff		Acid Mine Drainage Abatement & Sedimentation Control Programs
Stripmines *	Knott Breathitt	50	Troublesome Creek Buckhorn Cr.	Susp. Solids		Sedimentation Control Program
Stripmines *	Breathitt Knox	49	Quicksand Creek So. Fork Quicksand Creek	Susp. Solids		Sedimentation Control Program
Mining *	Letcher Perry Breathitt Lee	47,48,55,59	North Fork Kentucky River	Susp. Solids		Sedimentation Control Program
Frankfort	Franklin	12 & 13 15	Kentucky R. Elkhorn Cr.	Combined Sewers Urban Runoff		Separation of Combined Sewers Storm Water Management Program
Lexington	Fayette	16 17 18 25	N.Elkhorn C. S.Elkhorn C. Cane Run Cr. Hickman Cr.	Urban Runoff		Storm Water Management Program
Richmond	Madison	27 28	Tate Creek Otter Creek	Urban Runoff		Storm Water Management Program
Danville	Boyle	31	Clarks Run	Urban Runoff		Storm Water Management Program

Source * Kentucky Fisheries Bulletin No. 56, 1973
** Acid Mine Drainage in Appalachia, ARC, 1969

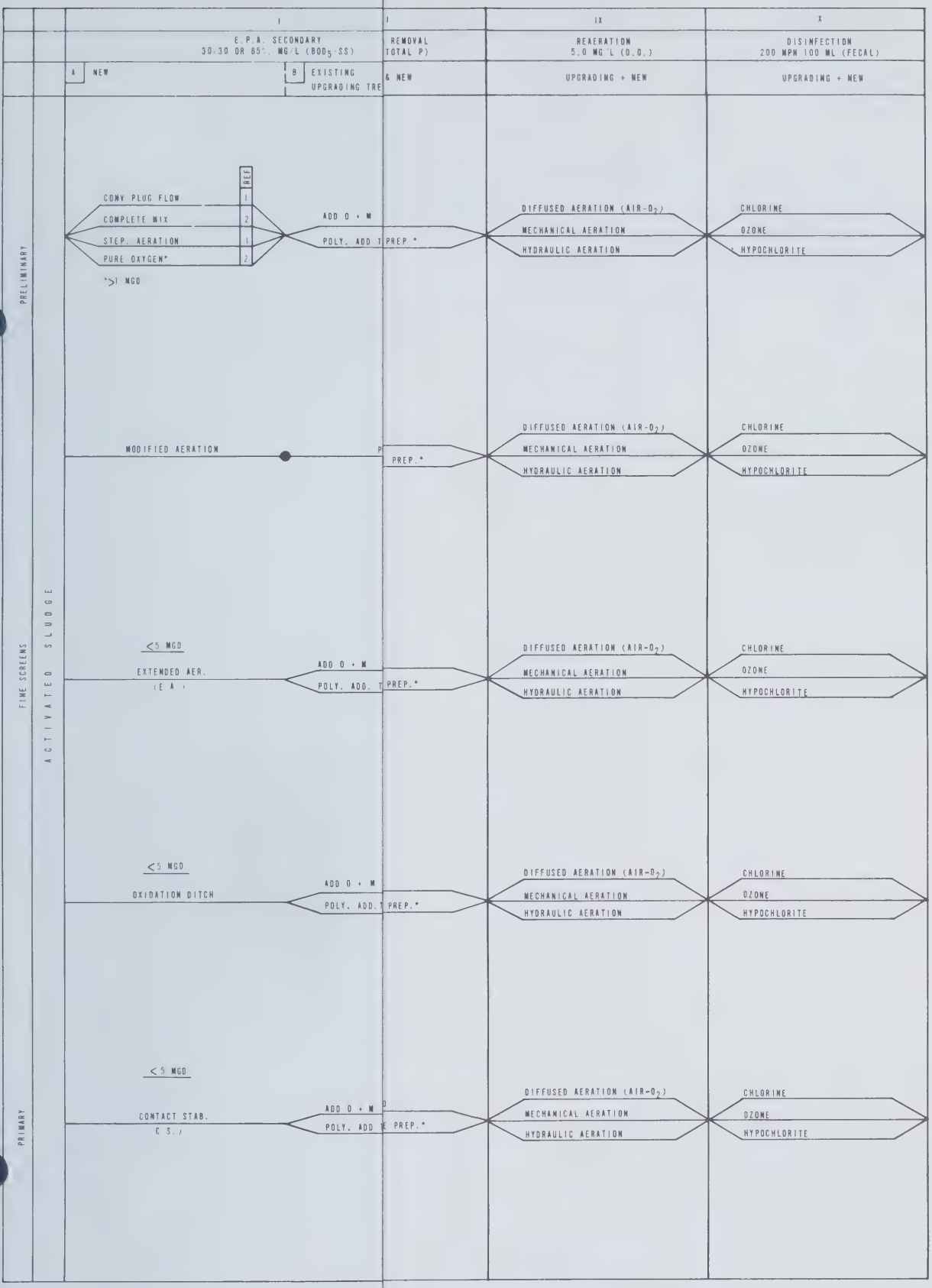


EXHIBIT 4.11t-A
WASTEWATER TREATMENT SYSTEMS FOR ACTIVATED SLUDGE OPTIONS

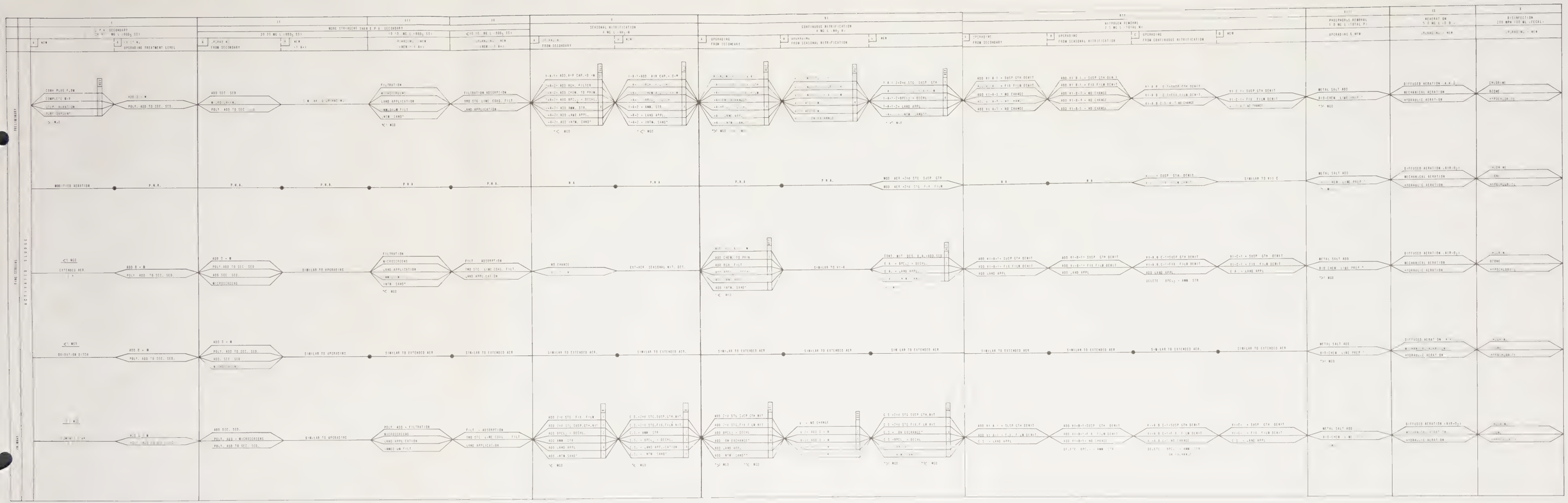


EXHIBIT 4.11t-A
WASTEWATER TREATMENT SYSTEMS
FOR ACTIVATED SLUDGE OPTIONS

METCALF & EDDY

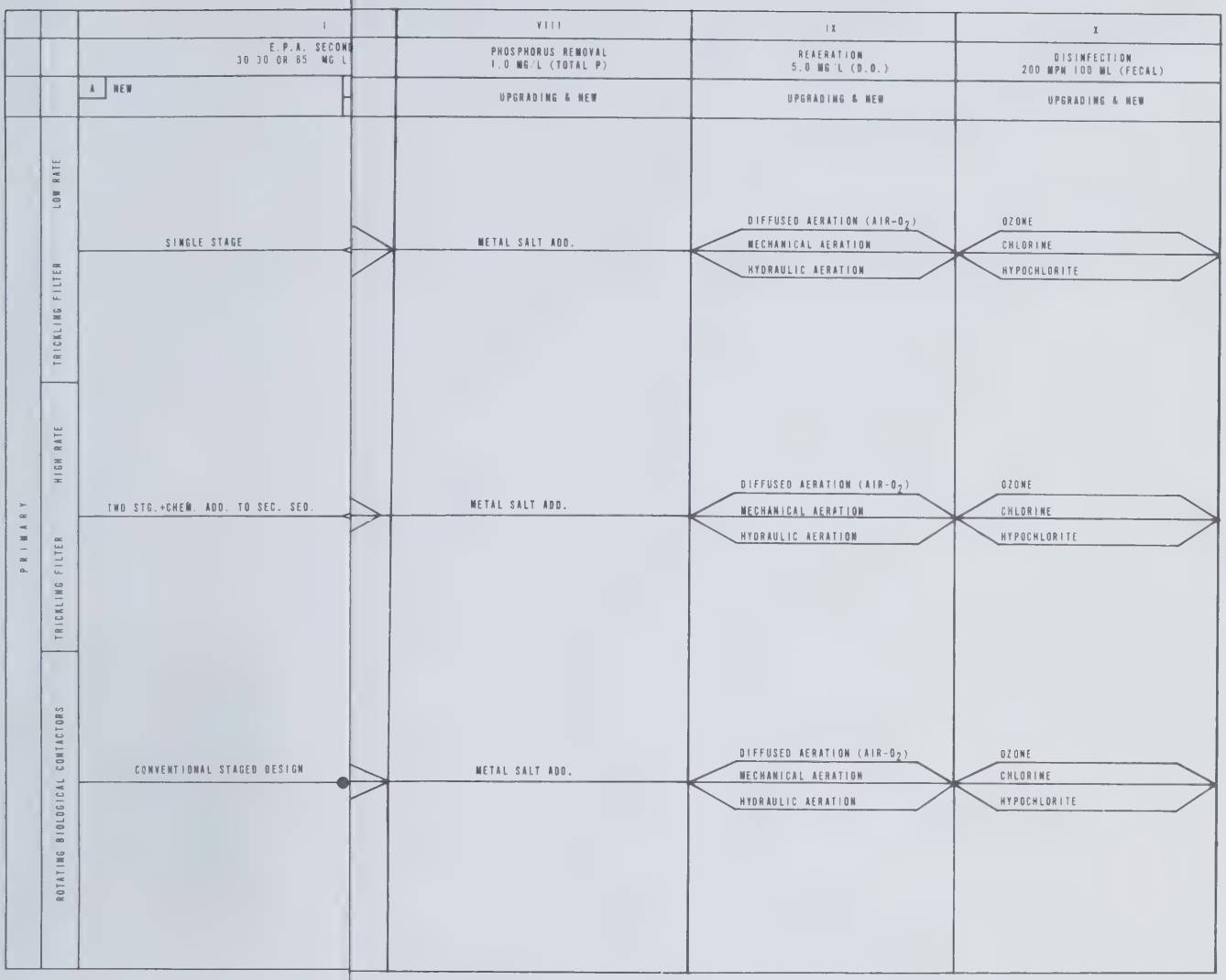


EXHIBIT 4.11t-B
WASTEWATER TREATMENT SYSTEMS
FOR FIXED FILM OPTIONS

METCALF & EDDY

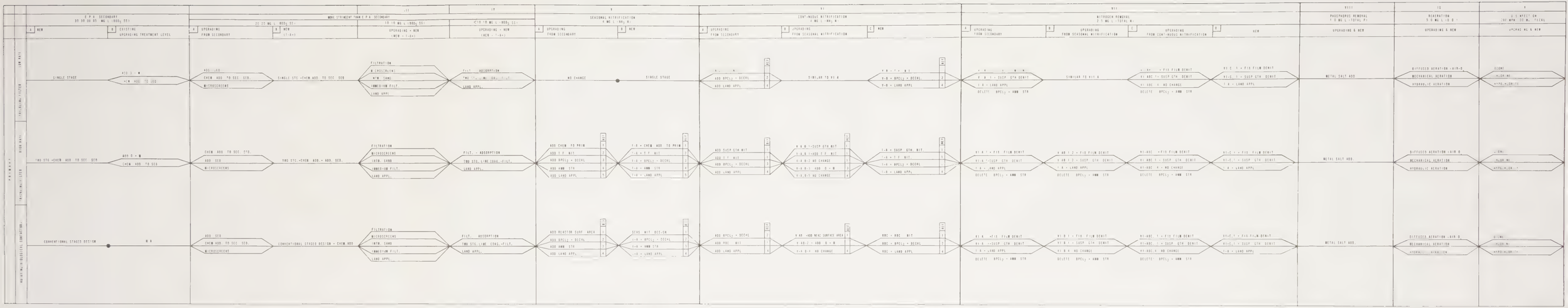


EXHIBIT 4.11t-B
WASTEWATER TREATMENT SYSTEMS
FOR FIXED FILM OPTIONS

METCALF & EDDY

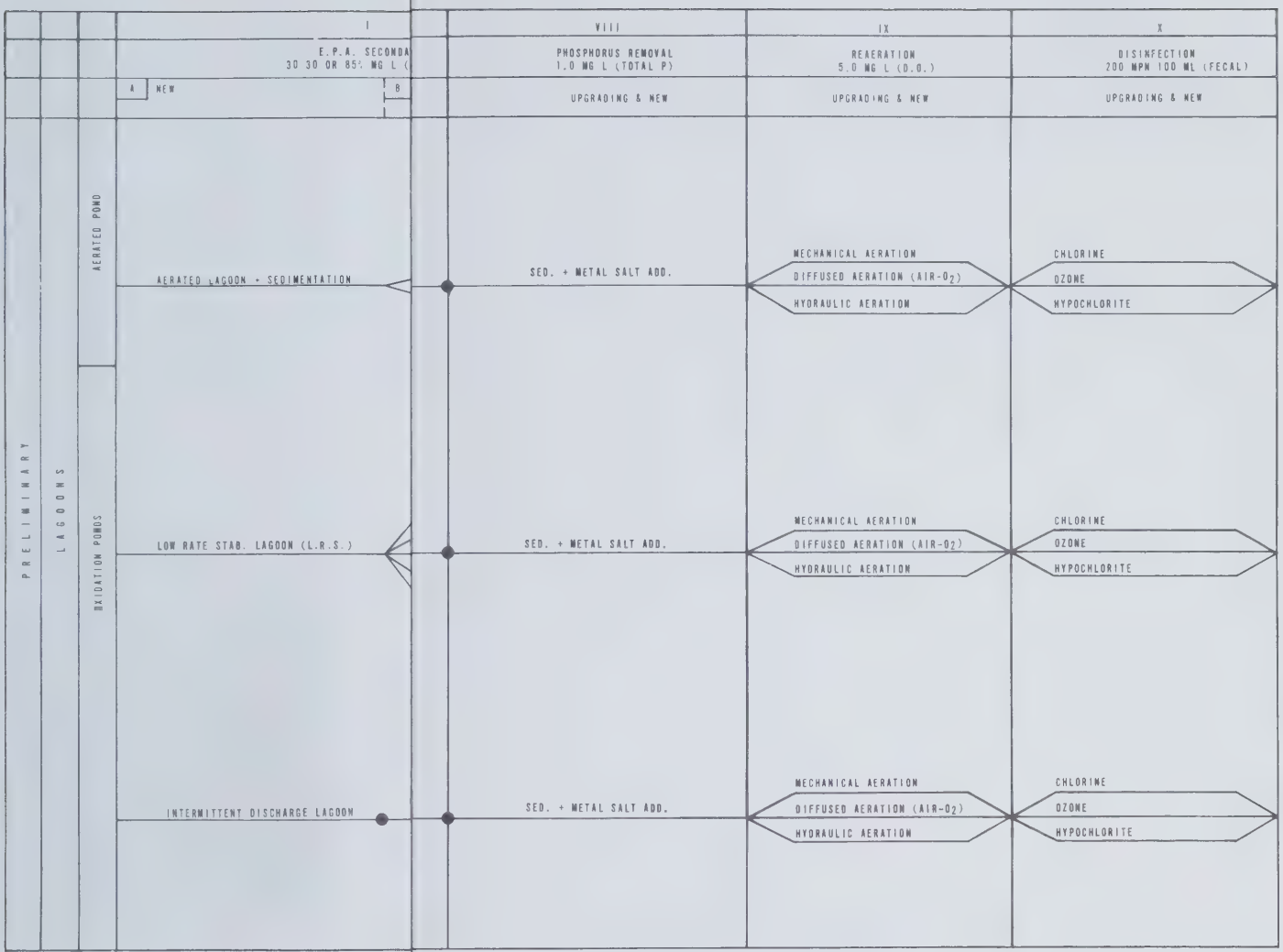


EXHIBIT 4.11t-C
WASTEWATER TREATMENT SYSTEMS FOR LAGOON AND POND OPTIONS

METCALF & EDDY

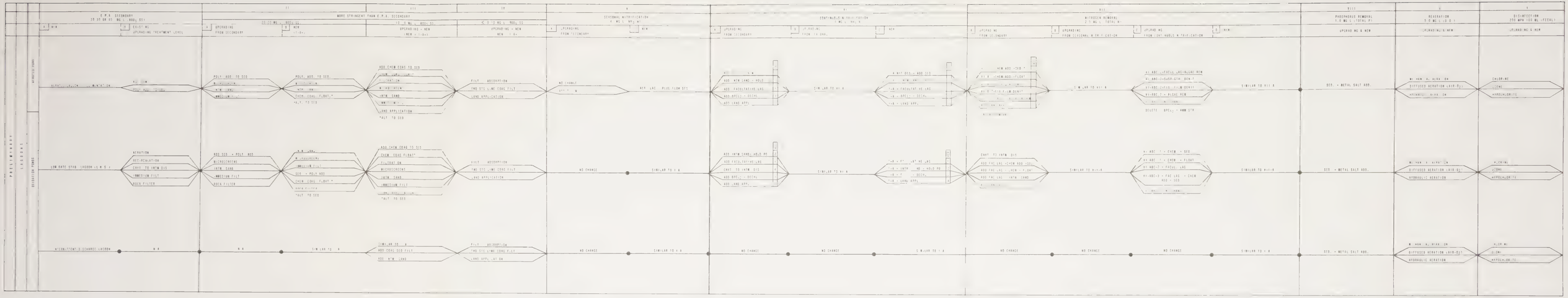
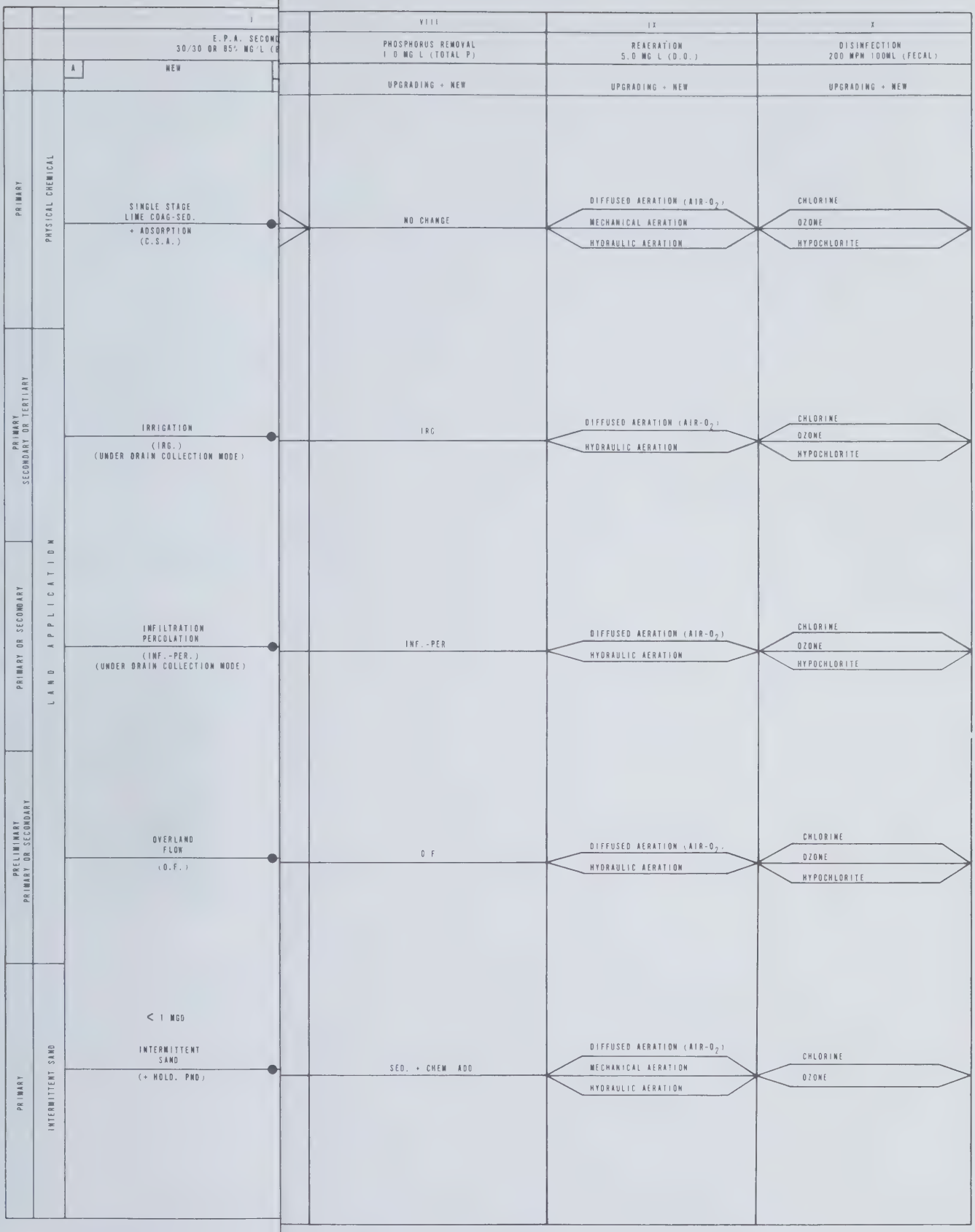


EXHIBIT 4.11t-C
WASTEWATER TREATMENT SYSTEMS
FOR LAGOON AND POND OPTIONS

METCALF & EDDY



*PROCESS APPLICATION TO COLD WEATHER DES
BASED ON pH CONTROL CHEMICAL COST SAVING
PRECIPITATION PROCESS.

EXHIBIT 4.11t-D
WASTEWATER TREATMENT SYSTEMS
FOR PHYSICAL-CHEMICAL AND
LAND APPLICATION OPTIONS

METCALF & EDDY

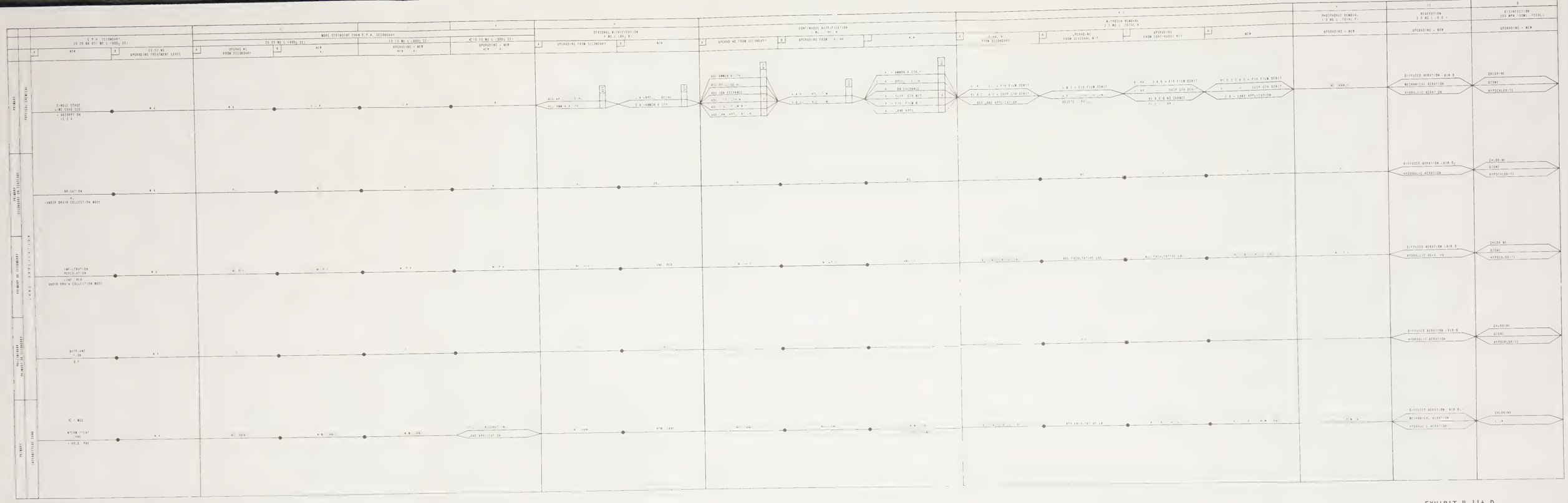


EXHIBIT 4.11t-D
WASTEWATER TREATMENT SYSTEMS
FOR PHYSICAL-CHEMICAL AND
LAND APPLICATION OPTIONS

METCALF & EDDY

and sediment runoff and have significant impact on streams in the watershed. Sediment control measures related to mining activity will be discussed in the following section on mining.

There are numerous sawmills in the mountainous portions of the basin. A listing is available in a publication entitled "Primary Wood Industries of Kentucky, 1974" (51). The location of those producing one million board feet or more in 1974 are shown on the segment maps, Exhibits B-6m through B-8m.

A potential source of stream pollution from lumber mills is leachate from the sawdust pile. Tanic acid resulting from decomposition of sawdust lowers the pH of leachate, which may be detrimental to aquatic life, particularly in the smaller streams. Currently available data are insufficient to assess the significance of individual sawdust piles on stream quality.

Mining

The two major problems associated with coal mining in the Headwater Section of the Kentucky River Basin are acid mine drainage and sedimentation.

Acid mine drainage is occurring mainly from abandoned deep mine sites. There are several coal seams which have a high potential for causing acid water conditions. Some of the seams containing material which results in acid water are Hazard No. 8 and 9, Blue Gem, and Stearns No. 2. More detailed information on acid bearing seams is contained in Report ARC-71-66-T5 prepared for the Appalachian Regional Commission (42).

There has been some stripping activity on acid seams, but at present there is little stripping activity on acid-bearing seams due to strip-mine regulations. It is more economical for the coal operators to strip non-acid coal and thereby avoid the problems and expense of treating the runoff to neutralize the acidity.

Streams which have significant acid water problems are illustrated on EXHIBIT 4.9m. This information is based on "Acid Mine Drainage in Appalachia" (1) and "The Kentucky Framework Water Plan" (63). The severest acid water problem comes from abandoned mines, including abandoned deep mines and pre-law strip mines. Streams which have continuous acid conditions and/or sediment load are listed in Exhibit 4.8t. The non-point source component of the priority formula for each segment is presented in Appendix B.

Sediment loads from haul roads, stripping operations, and sometimes areas permitted for deep mining, cause problems in streams in the Headwater Section. Sedimentation basins are now required by law (KRS Chapter 350) to intercept sediment from stripped areas. A registered professional engineer must design the sedimentation basins in accordance with established criteria of the Department for Natural Resources and Environmental Protection. These basins do intercept a good portion of the sediment from stripped areas when properly designed and maintained. However, in very steep terrain the dams are sometimes overtopped, resulting in failure and dumping of the sediment load into the receiving stream. When stripping occurs along ridges, sometimes sedimentation basins are not constructed on all streams leading away from the stripped area.

Erosion from coal haul roads is a universal problem throughout the Appalachian coal fields. Especially troublesome are abandoned roads where little or no attempt has been made to bed them down, and sediment runoff is a major problem. Current regulations require that side slopes of coal haul roads to strip mine areas be revegetated. but sedimentation basins to intercept runoff are not required because they are believed to be impractical for this application. There is currently a study underway for the Kentucky Department for Natural Resources and Environmental Protection on coal mine haul road sediment control. The results of this study are not available as of this date.

A study conducted by William R. Curtis (18) on surface-mined lands in the watersheds of Leatherwood Creek and Bear Branch indicated the highest sediment yields were measured during the first six-month period after mining. Methods of mining and handling the overburden were found to be more important than the amount of land disturbed. Reclamation measures, including quickly obtaining a vegetative ground cover, are important. With proper reclamation, the erosion rate diminished to fairly low levels within three years.

Surface clearing is allowed in the vicinity of areas permitted for deep mining but sedimentation basins are not required. Sediment from surface clearing can have a significant deleterious effect on small streams. Legislation has been recommended by the Department for Natural Resources that would require deep-mine operators to follow environmental guidelines currently required of surface mine operators.

Coal washing operations result in coal fines that usually settle out in sedimentation basins before the process water is discharged into the stream. These basins are occasionally subjected to flooding, which results in sediment entering the stream.

Gob piles, which are waste materials associated with mining consisting of poor quality (or reject) coal, slate and shale, are a source of pollution if such material contains acid producing minerals. These waste piles are often a source of stream sediment as well.

The current strip mine laws and regulations promulgated by the Department for Natural Resources and Environmental Protection have resulted in a tremendous improvement over the pre-law conditions. Where the requirements for sedimentation basins to intercept sediment from stripped areas and requirements for treating acid runoff have been properly enforced, the impact on streams has been reduced. However, improvements in mining techniques and reclamation methods for both new and orphaned mines are needed.

Also, means for reducing sediment runoff from haul roads and surface clearing around areas permitted for deep mining need further attention.

Urban Areas

Combined sewer systems with overflow points or by-passes to the stream occur when the combined sewer system is overloaded as a result of surface drainage. This is an apparent source of pollution. The City of Frankfort has such a system with numerous by-pass points. This condition is considered as a non-point source. A 201 study is now underway for the City of Frankfort which may better define the problem and recommend alternative methods for its solution. Carrollton is the only other city in the basin which is known to have some combined sewers. A 201 study is also underway for this city.

Metropolitan areas such as Lexington, Richmond, and Danville may be contributing a significant amount of stream pollution to the receiving stream as a result of surface runoff. There is not sufficient data currently available to make a determination as to the amount of water pollution occurring as a result of this condition in Lexington and other urban areas in the basin. A detailed study will be necessary to evaluate adequately the scope of these pollutional problems, as well as alternative solutions.

Sediment from development around urban areas can and often does create siltation problems. Erosion control measures, including sedimentation basins and immediate revegetation where possible, are acceptable solutions to the problem. A water management program is now underway in the Lexington area. Other cities or counties in the basin should consider legal requirements for revegetation and erosion control for disturbed areas.

Petroleum Operations

Oil waste and brine are potential pollutants from oil and gas producing areas. Effective laws and regulations have been promulgated by the Department for Natural Resources and Environmental Protection for control of these specific pollutants.

The provision of earthen embankments around oil separators, lagooning of oil waste to prevent accidental spillage into streams of the Commonwealth are in most cases required techniques for preventing pollution by these facilities. Brine wastes are reinjected into the subterranean waters from which they originated or into water-bearing strata of a similar type. Oil and gas wells must have a permit from the Department of Mines and Minerals for drilling purposes. The Department for Natural Resources, Division of Water Quality monitors oil and gas facilities for operation.

Upon the abandonment of a non-producing well, proper plugging is required by the Department of Mines and Minerals to prevent intrusion of saline waters into fresh water strata.

Sanitary Land Fills

Sanitary land fills are frequently a source of pollution if not properly designed and operated.

The Division of Solid Waste, Department for Natural Resources and Environmental Protection exercises authority over all sanitary landfill facilities within the Commonwealth. This Division of State Government has developed and promulgated regulations pertaining to development, maintenance and operation of these facilities.

A "Sanitary Landfill" has been defined as follows: "Sanitary Landfill" means a method of disposing of solid waste on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each day's operation or at such more frequent intervals as may be necessary." 1/

The regulations further stipulate that the landfill operations must be designed and operated in such a manner that unlawful pollution will not be created and that surface contouring of the landfill area shall be such that surface runoff will not flow into or through the landfill area.

In spite of the stringent requirements of the regulations related to solid waste management, pollution of the surface and underground waters frequently occurs as a result of leachate drainage. The amount and strength of such pollution is not known at this time, indicating the need for additional data.

Strenuous efforts have been made by state personnel to upgrade and promote adequate solid waste disposal facilities. Restraints that have been encountered fall into two primary categories: (1) Lack of adequate funding for development and operation, and (2) Lack of public acceptance of sanitary landfills near human habitations, the source of all solid waste generation. Additional information on solid waste management may be obtained from a publication entitled Urban Solid Waste Management from the Environmental Protection Agency (11).

1/ Kentucky Solid Waste Disposal Law and Regulations

WASTEWATER CONTROL NEEDS

Wastewater treatment technologies that will meet increasingly stringent effluent standards are developed in this section. In all,ten effluent standard categories are defined, and their relationships to effluent quality objectives are discussed. Following this general discussion, the effectiveness of the various technologies in acheiving BOD_5 and suspended solids removal, ammonia nitrogen removal, nitrogen removal, and phosporus removal is considered. Possible upgrading alternatives for existing activated sludge, fixed film and lagoon wastewater treatment systems are then, presented. The section closes with brief descriptions of the unit operations and unit processes which make up the wastewater treatment technologies considered in this section.

Wastewater treatment systems are composed of unit operations in which the application of physical forces predominate, and unit processes in which removal of pollutants is accomplished primarily by biological or chemical phenomena. Combinations of unit operations and processes have historically provided an extent of treatment known as primary or secondary. Treatment requirements beyond that provided by secondary unit operations have conventionally been termed as "tertiary treatment" or "advanced waste water treatment." Since the extent of treatment inferred by these terms is arbitrary, that treatment required beyond EPA-defined secondary may be determined by establishing the contaminant removals required prior to discharge or land application. The available unit operations and unit processes may then be grouped together on the basis of compatibility and performance criteria to obtain technologically feasible categories of effluent quality.

The conventional objectives of wastewater treatment are removal of 1) biodegradable organics, 2) suspended solids, and 3) nutrients (nitrogen and phosphorus), and 4) destruction of pathogenic organisms by disinfection.

The objectives of secondary treatment have been the removal of biodegradable organics and suspended solids, and disinfection. More stringent standards have recently focused on nutrient removal for control of eutrophication and ultimate oxygen demand.

The results of an investigation concerning effluent quality requirements and available treatment technologies are shown on Exhibit 4.11t. The available treatment technologies are applied to five major wastewater treatment systems to obtain up-graded effluent standards. The five major wastewater treatment systems considered are (a) activated sludge, (b) fixed film, (c) lagoons and ponds, (d) land application, and (e) physical-chemical.

Ten effluent categories have been selected for this study. Except for EPA-defined secondary treatment, the effluent categories selected primarily represent typical effluent characteristics obtainable from alternative combinations of wastewater treatment processes (i.e. categories are based on technological break points, not on effluent quality standards).

Treatment levels have been established by the State of Kentucky River Basin Planning Group. These treatment levels with their effluent characteristics are related to the effluent categories defined for this study as follows:

Treatment Levels	Effluent Characteristics (mg/L)			Effluent Categories
	BOD_5	NH_3-N	Do	
T1A	30	20	4	I
T1B	30	20	8	I & IX
T2A	20	15	4	II
T2B	20	15	8	II & IX
T3A	10	15	4	III
T3B	10	15	8	III & IX
T4A	10	4	4	III & VI
T4B	10	4	8	III & VI & IX
T5A	3	4	4	IV & VI
T5B	3	4	8	IV & VI & IX

The extent of unit operations and processes associated with each effluent category is primarily dependent on the basic BOD removal processes available and modifications required to meet upgraded effluent standards. The five basic types of biological removal processes are biological suspended growth, biological fixed film, lagoon options, land application, and physical-chemical treatment. The extent of treatment or number of unit processes required to meet a certain effluent category is also dependent upon the number and type of existing facilities and flow range. In certain instances, the application of alternative wastewater treatment processes has been divided into two basic design flow ranges, less than 1 mgd, and greater than 1 mgd. These design flow ranges have been selected to provide flexibility and sensitivity in projecting the application of alternative technologies.

The series arrangements in Exhibit 4.11t of effluent quality standards and related applicable treatment unit processes does not necessarily imply a continuous series addition of treatment processes to obtain any one or any combination of desired effluent quality. All treatment processes which are individually capable of meeting any given combination of desired effluent quality would supersede the application of repetitive process requirements. For example a treatment process listed in effluent category VIII may also accomplish some or all of the effluent criteria of categories I through VII.

The ten effluent categories may be combined into 6 basic objectives of wastewater treatment according to effluent quality as follows:

Effluent Categories	Effluent Quality Objectives
I, II, III, IV	Carbonaceous BOD_5 and SS removal
V, VI	Nitrification
VII	Nitrogen removal
VIII	Phosphorus removal
IX	Reaeration
X	Disinfection

Effluent Category I represents EPA-defined secondary treatment effluent standards and constitutes minimum treatment requirements. These effluent standards require BOD_5 and suspended solids effluent concentrations not to exceed 30 mg/l. Effluent Categories II, III, and IV represent increasingly stringent levels of BOD_5 and suspended solids removal. Effluent Category II includes all standards that permit concentrations of both BOD_5 and suspended solids to within a range of 20 to 30 mg/l. Effluent Categories III and IV include all standards which require both BOD_5 and suspended solids concentrations within a range of 10 to 20 mg/l, and less than 10 mg/l respectively. The applicability of utilizing various unit operations and processes to achieve these effluent standards is discussed later in this Chapter.

Effluent Category V, seasonal nitrification to 4 mg/l NH_3-N, represents seasonal ammonia nitrogen oxidation to nitrite and nitrate. The 4 mg/l ammonia nitrogen value is intended to represent the limitations of the least efficient processes likely to be implemented for seasonal nitrification requirements. The process requirements incorporated within new systems will generally produce a better quality of effluent when compared to that available from process requirements applicable to upgrading existing secondary facilities.

Effluent Category VI, continuous nitrification to 4 mg/l NH_3-N, represents continuous oxidation of ammonia nitrogen. This category of effluent quality will generally require process additions to conventional secondary treatment.

Effluent Category VII, nitrogen removal to 2-5 mg/l total nitrogen, represents typical total nitrogen standards when such are established. Nitrogen removal to the stated effluent quality range represents two different systems applications. The lower range represents the minimum effluent concentrations currently feasible with available technologies. The upper range represents the application of ammonia removal processes - breakpoint chlorination and ammonia stripping - to biological secondary treated effluent. Nitrification must be limited in the secondary treatment carbonaceous oxidation process in order to meet the 5 mg/l total nitrogen effluent standard.

A particular note need be referenced to the fixed film nitrogen removal effluent category. Ammonia removal process additions to fixed film biological systems are not conventionally capable of obtaining the required nitrogen removal standards. The two limiting factors are the lack of control of nitrification in warm temperature conditions and the insufficient oxidation of organic nitrogen to ammonia nitrogen in cold temperature operation. Existing or sequential upgrading from secondary treatment, seasonal nitrification, and continuous nitrification are detailed in addition to new process application.

Effluent Category VIII represents phosphorus removal to 1.0 mg/l total phosphorus. The predominant process application for this effluent quality is metal salt addition to secondary or tertiary clarification process.

Effluent Category IX, comprises reaeration to 5 mg/l DO. The selection of alternative processes available for reaeration will vary according to the type of secondary treatment process and the applicable flow range.

Effluent Category X, disinfection to 200 MPN per 100 ml. (fecal coliform) is intended to represent the EPA secondary treatment requirement.

BOD_5 and Suspended Solids Removal

Effluent Categories I, II, III and IV in Exhibit 4.11 are intended for the removal of BOD_5 and suspended solids. Effluent Category I is EPA-defined secondary treatment to achieve a concentration of 30 mg/l for both BOD_5 and suspended solids. Effluent Category I can normally be achieved by conventional activated sludge, fixed film, lagoons or land application processes.

Effluent Category II can normally be obtained by well operated, conservatively designed activated sludge processes. This category of effluent can also be achieved and exceeded by land application techniques following primary or secondary treatment processes.

Fixed film plants, as well as highly loaded activated sludge processes, will normally require the addition of chemicals to the secondary settling tanks and in some instances additional final settling tank capacity to achieve a concentration of 20 mg/l of both BOD_5 and suspended solids.

Effluent Categories III and IV, with the exception of processes using land application techniques, can only be achieved through the addition of process units to the basic treatment train (activated sludge, fixed film, physical-chemical). For these three treatment trains, the additional process units provide sequentially, as required, some form of filtration, absorption or chemical treatment.

Physical chemical processes followed by a biological activated sludge process will also achieve both effluent categories.

Ammonia Nitrogen Removal

Effluent Categories V and VI in Exhibit 4.11t are designed for nitrification or ammonia nitrogen removal. The selection of the appropriate processes to achieve nitrification of the wastes depends to a great extent on whether or not nitrification will be required during warm weather periods or throughout the year. This is so because the basic treatment processes, such as activated sludge and fixed film, can be designed or modified to provide the degree of nitrification required during warm weather

conditions. It is for this reason that Exhibit 4.11t has two categories for effluent upgrading, one seasonal and the other for continuous operation.

In a system where continuous nitrification is required, biological suspended growth, fixed film, break point chlorination and ion exchange processes are all applicable. The selection of any particular process must of necessity be job specific, taking into consideration local factors such as overall effluent requirements, local economic and site conditions, and available operational skills.

Nitrogen Removal

Effluent Category VII is designed for nitrogen removal. Nitrogen removal can be required to limit eutrophication problems, and to limit the nitrate content where the receiving waters are used as a source of water supply. Since eutrophication problems are more economically, and normally better controlled through the limitation of phosphorus as a nutrient, nitrogen removal for this purpose is not widely practiced.

The selection of any particular process for the removal of nitrogen, depends to a great extent on the degree of nitrification that can be anticipated in the preceeding process train. This is so, because such processes as ammonia stripping, break point chlorination and the ion exchange require a minimum nitrified influent if they are to operate efficiently. In other cases, the preceeding process may inherently produce an effluent of such chemical composition, that it becomes advantageous to utilize a particular process for nitrogen removal. For example, the physical-chemical process can be easily operated to produce an effluent that will have a proper pH range for the efficient operation of the ammonia stripping process.

Phosphorus Removal

Carbon is a major eutrophic nutrient which occurs in such abundance naturally that it cannot be controlled by man. Phosphorus is a key nutrient in the control of eutrophication which can in part be controlled by man. Although phosphorus sources include runoff, industrial wastes, domestic wastes and animal wastes, the most controllable source of phosphorus in aquatic systems is municipal waste.

The major aquatic systems in which phosphorus creates problems are lakes, reservoirs, impoundments and other such water bodies. In these systems the hydraulic detention periods are great enough to allow for the quiescent conditions necessary for the proliferation of nitrogen-fixing blue-green algae. Normally the creeks, streams and rivers are not quiescent and therefore generally the algae growth is not a problem.

The phosphorus concentration is a typical municipal wastewater is about 10 mg/L. It has been reported that municipal wastes may be reduced by as much as 50 percent by eliminating the use of phosphates in detergents. Reduction of phosphates to minimal levels in municipal wastes may be accomplished by the addition of metal salts (aluminum or iron) and/or lime. The cost of this type of treatment is a factor in overall operating costs of treatment facilities.

Domestic wastewaters contain nitrogen to phosphorus ratios of about 3 to 4 parts of nitrogen to 1 part of phosphorus. Since green and blue-green algae cells normally contain 12 to 15 parts of nitrogen to 1 part of phosphorus, domestic wastewaters contain an excess of phosphorus over that amount that these algae are able to use. This excess quantity can be utilized by certain nitrogen fixing algae in nitrogen deficient waters and this is one of the mechanisms through which excessive algae blooms can occur, resulting in an increase in the nitrogen budget.

All algae, both green and blue-green thrive as long as both nitrogen and phosphorus are present. If nitrogen becomes limiting, certain species of blue-green algae, namely Nostoc, Anabaena, Aphanizomenon and Gleotrichia can still continue to thrive as long as phosphorus is available. This situation develops in lakes and reservoirs but has not been known to exist in rivers, except possibly in backwater areas.

Where phosphorus is present in excess, most algae use nitrogen and phosphorus in a ratio of about 15 to 1 and will flourish up to ratios of 30 to 1. Before phosphorus can become limiting, the phosphorus level must be reduced to less than 0.5 mg/L when total nitrogen equals 15 mg/L or less than 1.0 if it equals 30 mg/L. This criteria for limiting the discharge of phosphorus is only recommended in treatment plants tributary to impoundments and where there is clear evidence of excessive eutrophication. Removal of nitrogen on the basis of controlling eutrophication does not appear warranted.

As a concrete example of corrective action, municipal waste treatment plants which discharge into impoundments may consider including the facilities necessary for the future addition of metal salts. These features can be included during the next alteration or expansion program. The addition of the metal salts may not be necessary until the monitoring program determines that a potential problem exists.

Use of Exhibit 4.11t

To illustrate the use of Exhibit 4.11t, an example of upgrading an existing wastewater treatment system for an activated sludge option is presented.

Assume that a recently built activated sludge treatment plant of the conventional plug-flow design, which is presently operating to meet EPA-defined secondary treatment, needs to be upgraded to meet more stringent effluent requirements. The recently built plant is shown on Exhibit 4.11t-A under category I-A-1, where I indicates category I, A means a new or recently built plant, and 1 means reference 1 which indicates a conventional plug flow design. To simplify the selection process for upgrading, the plant flow is assumed to be greater than 1 mgd. Assume further that the treatment plant needs to be upgraded to achieve an effluent of 10 mg/L BOD_5 and 10 mg/L SS, and is required to achieve seasonal nitrification at present and continuous nitrification in the near future. There is also a possibility that nutrient removal, and reaeration may be required. Disinfection will also be required.

The effluent requirements for BOD_5 and SS indicate that the treatment plant must meet Effluent Category III. Under Effluent Category III, there are four available alternatives to upgrade an existing plant. These are: filtration, microscreens, land application, or immedium filtration. Any of these processes may be used to meet the BOD_5 and SS requirements. Intermittent sand filtration is not considered because the flow is greater than 1 mgd.

A conservatively designed conventional activated sludge treatment plant with proper operation and maintenance will normally achieve seasonal nitrification. Therefore, assuming that the plant is conservatively designed, in Effluent Category V under A - upgrading from secondary, there is only one alternative for the conventional plug-flow design -- that of adding air capacity and improving oepration and maintenance. This completes the present treatment requirements. The plant, with seasonal nitrification now appears in Exhibit 4.11t-A at V-A-2, a conventional plug-flow design with added air capacity and improved operation and maintenance. Also, an effluent polishing technique has been added to reduce the effluent BOD_5 and SS each to 10 mg/L.

In the future when it becomes necessary to upgrade the treatment plant to achieve continuous nitrification, three alternatives will be available. In continuous nitrification under Effluent Category VI, under B - upgrading from seasonal nitrification, the three available alternatives following V-2 are: to add a second stage suspended growth nitrification unit, to add a second stage fixed-film nitrification unit, or to add an ion exchange unit. The plant now appears in Exhibit 4.11t-A at VI-B-1 with the addition of either nitirification unit alternatives, or at VI-B-3 with the addition of the ion exchange unit alternative.

If, in addition, nutrient removal (total nitrogen and total phosphorus) is also required, Exhibit 4.11t-A gives alternatives for obtaining these effectively. In Effluent Category VII, under C - upgrading from continuous nitrification, the alternatives are presented for total nitrogen removal. For the treatment plants at VI-B-1 with nitrification units either a suspended growth denitrification unit or a fixed-film denitrification unit could be added. If however the ion exchange unit had been chosen to achieve continuous nitrification, no further treatment would be required, since this process achieves the total nitrogen reduction as required.

If phosphorous removal is also required, effluent Category VIII presents two alternatives for phosphorus removal: metal salt addition to either primary or secondary treatment, or biological-chemical lime precipitation.

If reaeration of the effluent is required, effluent Category IX, presents three alternatives for achieving a minimum D.O. of 5 mg/l. These alternatives are: diffused aeration, mechanical aeration, or hydraulic aeration.

Effluent Category X, disinfection, presents three alternatives for meeting a fecal coliform count of 200 MPN/100 ml. These options are: an addition of chlorine, ozone, or hypochlorite.

Possible Upgrading Alternatives

Exhibit 4.11t is designed to indicate the most feasible technologies that are available to achieve any particular quality of effluent. This technology can be applied in new or upgrading situations.

Historically, many of the urban centers and small communities have provided wastewater treatment plants which incorporated the latest technology available at the time of design. In such cases, the effluent standards set by the regulatory agencies, the ease of operation, and local parameters were used in selecting the design technology. As the available technology has become more sophisticated and as the public has become more aware of the environmental impacts of wastewater pollution, the effluent standards have become more stringent. Accordingly, many of the existing wastewater treatment plants will require upgrading to meet these new standards.

Of particular interest is the technique that will be used in upgrading existing small wastewater treatment plants. This is because in the aggregate, these plants represent a large economic investment and, therefore, should have a capability of expansion and should provide some measure of flexibility and ease of operation.

In the following paragraphs various techniques that can be reasonably applied to upgrade activated sludge, fixed film and lagoon wastewater treatment systems to produce a nitrified effluent low in BOD_5 and suspended solids are presented and discussed.

Activated Sludge

Existing Activated Sludge wastewater treatment plants can be upgraded by using the following techniques:

Unit Process	Alternative			
	1	2	3	4
Continuous Nitirification	Add Suspended Growth	Add Fixed Film	Add Breakpoint Chlorination-Dechlorination	---
Polishing BOD_5 and Suspended Solids Removal	Multi Media Filter	Multi Media Filter	Multi Media Filter	Infiltration Percolation
Reaeration	Mechanical Aeration, Diffused Air, or Cascade	Mechanical Aeration, Diffused Air, or Cascade	Mechanical Aeration, Diffused Air, or Cascade	---
Disinfection	Chlorination	Chlorination	---	---

Under Alternative 3, the multimedia filter process should preceed the breakpoint chlorination-dechlorination process within the treatment train. This procedure will reduce the chlorine demand of the wastewater effluent. The techniques shown above usually apply to plants that have design capacities in excess of 1 mgd. With the exception of Alternative 3, all of the alternatives are adaptable to plants having capacities of less than 1 mgd. Alternative 3 is not readily used in small plants because of the complexity and difficulty of properly controlling the breakpoint chlorination-dechlorination process. The land application technique may be more advantageously and more properly applied to small plants because of the reduced land requirements. Alternative 4 is a land application technique, and as such is applicable only in those situations where the soil characteristics and groundwater hydrology will permit land disposal.

Fixed Film

Single stage high rate fixed film wastewater treatment plants can be upgraded by the following procedures:

Unit Process	Alternative			
	1	2	3	4
Increased BOD_5 & Suspended Solids Removal	Additional High Rate Stage	Additional High Rate Stage	Additional High Rate Stage	Additional High Rate Stage
Continuous Nitrification	Suspended Growth	Fixed Film	Breakpoint Chlorination-Dechlorination	---
Polishing BOD_5 and Suspended Solids Removal	Multi-Media Filter	Multi-Media Filter	Multi-Media Filter	Infiltration-Percolation
Aeration	Mechanical Aeration, Diffused Air, or Cascade	Mechanical Aeration, Diffused Air, or Cascade	Mechanical Aeration, Diffused Air, or Cascade	---
Disinfection	Chlorination	Chlorination	---	---

The most common method of sludge drying and disposal in the Kentucky River Basin involves the use of sand drying beds for drying of digested sludge. The beds are usually rectangular in shape, have concrete floors and are surrounded by low walls about three feet high. Provisions are made for removing of the filtrate liquid through an underdrainage system. The liquid must be returned to the plant influent. Sludge is drained onto the bed to a depth of about nine to twelve inches and allowed to drain and dry. Dewatering of the sludge is achieved both by evaporation and by water drainage through the underdrain system.

Subsequent to drying the sludge is forked onto trucks for disposal to land or stockpiled on the plant site. In some locations throughout the Commonwealth the dried sludge is applied to agricultural land, in other areas disposal of sludge is difficult.

The most logical place for disposal of excess dried sludge is within the community sanitary landfills that have been licensed by the Division of Solid Waste. A compilation of these facilities are shown on Exhibit 4.12t.

It has been estimated that sludge generation from all sources within the basin will amount to approximately one cubic foot per one hundred persons. This includes septic tank waste, treatment plant waste and other domestic wastes. Based on this estimation, the amount of sludge in cubic feet per day for each county or portion thereof is listed on Exhibit 4.12t.

The existing capacity of the licensed disposal sites was unavailable and represents an information need that should be developed by the Division of Solid Waste, Department for Natural Resources and Environmental Protection.

As in the case of activated sludge plants, the procedures above usually apply to plants larger than 1 mgd in capacity. For reasons previously stated, the breakpoint chlorination-dechlorination technique is usually not applicable to plants of less than 1 mgd in capacity, and the land application technique may be more reasonably adapted for smaller plants. The essence of the proposed treatment trains is providing an additonal high rate stage in the fixed film process, to ensure a reduced BOD_5 load in the continuous nitrification process that follows the high rate stage. In some instances, it may be possible to design the continuous nitrification unit to properly nitrify on a year around basis the effluent from the existing single stage high rate fixed film wastewater treatment plant. In such cases, the additional high rate stage process will not be required.

Lagoons

Facultative lagoons in cold weather climates cannot consistantly produce effluents that will meet secondary treatment standards. One mode of operation that can provide a higher quality of effluent is to have sufficient capacity to store wastewater during the winter months and discharge when the wastewater is of proper quality. Since the necessary input data to permit this mode of operation can only be obtained empirically and is site specific, the system does not lend itself to general selection procedures.

Facultative lagoons are normally designed to produce algae for the purpose of oxygen production, and to convert organic and inorganic pollution loads to cellular matter. The discharge of cellular matter that has an oxygen demand can have an adverse effect on the dissolved oxygen content within the receiving stream. One method of overcoming this objection is to aerate the wastewater contents of the lagoon by mechanical means, and to filter the effluent to remove any cellular matter. With the proper choice of design parameters, such a system can produce an effluent that is well nitrified and that has a low BOD_5 and suspended solids content.

DESCRIPTION OF INDIVIDUAL PROCESSES

The unit operations and unit processes that are designated in Exhibit 4.11t are briefly described in the following paragraphs:

Preliminary Treatment

Conventional:

The main objective of preliminary treatment is the removal of coarse solids. This is usually accomplished with bar racks or screens. Comminutors are sometimes used in place of racks or screens to grind up the solids without removing them from the wastewater. Grit chambers are designed to remove grit, consisting of sand, gravel, cinders, or other heavy solid materials that have settling velocities or specific gravities substantially greater than those of the organic putrescible solids in wastewater. Skimming tanks, grease traps, preaeration, and flocculation are additional processes that may be used to make primary treatment more effective.

Fine Screen:

Fine screens, or inclined wedge-wire screens, are static gravity strainers whose function is to remove solids. Fine screens can be used in lieu of conventional preliminary treatment and in some cases for primary treatment.

Primary Treatment

Sedimentation:

Primary sedimentation is used to remove settleable and floating material from wastewater under quiescent conditions. Sludge is collected in a hopper at the bottom of the tank and scum is skimmed from the surface. Chemicals may be added to promote the precipitation of phosphorous compounds, BOD_5 and suspended solids.

Secondary Treatment - Activated Sludge

The activated sludge process uses suspended microorganisms to oxidize, in the presence of molecular oxygen, soluble and colloidal organics contained in

domestic wastewaters. During the oxidation process, new cells are synthesized. Some of the synthesized cells undergo auto-oxidation in the aeration tank, the remainder forming excess sludge. Oxygen is required in the process to support the oxidation and synthesis reactions. The solids generated must be separated in a settling tank, with the largest portion returned to the aeration tank, and the excess sludge withdrawn from the system for further handling and disposal. Due to the flexibility of the process an activated sludge plant may have various modifications.

Conventional (Plugflow):

One modification is referred to as the Conventional (Plugflow) process. In this process the return sludge is mixed with the incoming wastewater to the aeration tank, and the combined flow passes through the aeration tank with a minimum of mixing (Plugflow). The rate of return sludge usually varies from 15 to 75 percent of the average design flow, with an average rate of return of about 25 percent. The oxygen is normally supplied from an air source, and is dispersed in the aeration tank by mechanical or diffused air techniques.

Design of conventional activated sludge systems is generally based upon application of a volumetric loading rate and a relationship between the incoming organics and the amount of organisms in the system. The volumetric loading generally ranges between 20 and 40 lb. BOD_5/day/1000 ft.^{3}; the ratio of incoming organics to cells in the system (F/M) is generally between 0.2 and 0.4 lb. BOD_5/lb. MLSS/day. At conservative design loading rates this process will also provide seasonal nitrification of wastewater effluent.

The process has certain design and operating limits, and for this reason other modifications have been developed.

Complete-Mix:

In the complete-mix process, influent wastewater and recycle sludge are uniformly distributed throughout the aeration tank. This flow distribution results in a more uniform oxygen demand throughout the aeration tank when compared to the Conventional (Plugflow) process. This permits a greater operational stability when the system is subjected to slug loads. The process can be designed to accept higher volumetric loadings than the Conventional process with little, if any, reduction in efficiency. Volumetric loadings are 30-50 lb. BOD_5/day/1000 ft.^{3}. The F/M ratio is 0.3-0.5 lb. BOD_5/lb. MLSS/day.

Step Aeration:

In a step aeration process, the influent wastewater is introduced at several points along the aeration tank. The return sludge is introduced at the head end of the tank as is the Conventional process. The process can accept higher volumetric loadings than the conventional process, without any reduction in treatment efficiency. Since the incoming flow is distributed along the length of the aeration tank, the initial oxygen demand is reduced below that experienced in the Conventional process. Volumetric loadings are 40-60 lb. BOD_5/day/1000 ft.^{3}. The F/M ratio is 0.2-0.4 lb. BOD_5/lb. MLSS/day.

Pure Oxygen:

The use of pure oxygen rather than air as a source of molecular oxygen, has the advantage of permitting the highest available volumetric loadings of any known process, with a corresponding reduction in aeration rank capacity. The system also has the advantage of maintaining a high dissolved oxygen content in the effluent, and effective odor control. Pure oxygen systems are generally enclosed and operate under a slight pressure in an oxygen rich atmosphere. Volumetric loadings are 150-225 lb. BOD_5/day/1000 ft.^{3}. The F/M ratio is 0.5-0.8 lb. BOD_5/day/1000 ft.^{3}.

Modified Aeration:

The flow patterns for the incoming wastewaters and the returned sludge are the same as in the Conventional process. Since they are operated at substantially higher volumetric loadings, and F/M ratios, the biological activity is reduced. Aeration requirements and efficiencies are less than those of the conventional system due to this reduced biological activity. The volumetric loading is 75-150 lb. BOD_5/day/1000 ft.^{3}. The F/M ratio is 1.5-5.0 lb. BOD_5/lb. MLSS/day.

Contact Stabilization:

As in the step aeration process this modification involves a change in feed location to the aeration tank. In the process, the return sludge is returned to a reaeration tank, and the incoming wastewater is mixed with the reaerated sludge in a contact tank. Air requirements are similar to those of the conventional process. The process, similar to the step-aeration process, is capable of accepting higher volumetric loadings than the conventional process without reduction in efficiency. Volumetric loading is 40-60 lb. BOD_5/day/1000 ft.^{3}. The F/M ratio is 0.20-0.4 lb. BOD_5/lb. MLSS/day.

Extended Aeration:

The extended aeration process is a complete mix system that is designed to operate in the endogenous phase of the growth curve. This necessitates a relatively low organic loading and long aeration time. For this reason, the process is generally applicable only to small wastewater treatment plants of less than 1 mgd. capacity. Volumetric loading is 10-15 lb. BOD_5/day/1000 ft.^{3}. The F/M ratio is 0.03-0.10 lb. BOD_5/lb. MLSS/day.

Oxidation Ditch:

The oxidation ditch process is an extended aeration process that can be designed to operate on an intermittent or continuous basis. Oxygen for the process is supplied from an air source by means of a series of hydraulically operated motors. Due to the allowable loadings, the process is applicable only to small treatment plants. Volumetric loading is 10-15 lb. BOD_5/day/1000 ft.^{3} and

the F/M ratio is 0.03-0.10 lb. BOD_5/lb. MLSS/day.

Secondary Treatment-Fixed Film

Trickling Filters Low Rate:

A trickling filter is a biological reactor which provides surface area upon which microorganisms can grow. Wastewater is applied intermittently to the top of a bed of coarse stone or synthetic media. While percolating through the filter, the wastewater flows over the microbial film and the soluble organics are readily metabolized and the colloidal organics are absorbed onto the surface. The wastewater is collected at the bottom of the filter in an underdrain system and conveyed to a settling tank where excess biological growth is separated from the liquid effluent.

When used for conventional secondary treatment, low-rate trickling filters are designed for hydraulic loadings of 1-4 mgd/acre, and organic loadings of 5-20 pounds of BOD_5/day/1000 ft.3. Depending on the climate, conservative design loading rates may provide nitrification of the wastewater effluent.

Trickling Filters High Rate:

The biological process involved is the same for the low-rate trickling filters. High-rate trickling filters used for conventional secondary treatment are designed for hydraulic loadings of 10-40 mgd/acre and organic loadings of 30-60 lb. BOD_5/day/1000 ft.3. In contrast to the low-rate system, the recirculation of filter or clarifier effluent permits both higher and more uniform hydraulic loadings. However, the higher organic loadings do not permit nitrification to occur as readily as in low-rate systems.

Rotating Biological Contractors:

Rotating Biological Contractors (RBC's) consist of a series of closely spaced circular discs of polyvinylchloride, 40 percent submerged in a vat of wastewater, and rotated slowly through the water. Biological growths become attached to the surface of the discs and eventually form a slime layer over the entire surface area of the discs. The rotation of the discs alternately contacts the biomass with the organic material in the wastewater and then with the atmosphere for absorption of oxygen. The disc rotation affects oxygen transfer and maintains the biomass in an aerobic condition. The rotation is the mechanism for removing excess solids from the discs by the shearing forces it creates, and also the means of maintaining the sloughed solids in suspension so they can be carried from the unit to a clarifier. In addition to their use for secondary treatment, RBC's can also be operated to accomplish seasonal and continuous nitrification.

Secondary Treatment Lagoon

Aerated:

An aerated lagoon is a basin in which wastewater is treated on a flow-through basin. Oxygen is usually supplied by means of surface aerators or diffused aeration units. The action of the aerators and that of the rising air bubbles from the diffuser is used to keep the contents of the basin in suspension. In effect the essential function of this type of lagoon is waste conversion. In a completely mixed lagoon neither the incoming solids nor the biological solids produced settle out. Depending on the detention time, the effluent will contain about one-third to one-half the value of the incoming BOD_5 in the form of cell tissue. Before the effluent can be discharged, however, the solids must be removed by settling.

Low-Rate Stabilization:

A stabilization lagoon is a body of water contained in an earthen basin of controlled shape, which is designed for the purpose of treating wastewater. These ponds are also called oxidation ponds. Three zones exist in these ponds: (1) a surface zone where aerobic bacteria and algae exist in a symbiotic relationship, (2) an anaerobic bottom zone in which accumulated solids are actively decomposed by anaerobic bacteria, and (3) an intermediate zone that is partly aerobic and partly anaerobic, in which the decomposition of organic wastes is carried out by facultative bacteria. In these ponds, the suspended solids in the wastewater are allowed to settle to the bottom. The maintenance of the aerobic zone serves to minimize odor problems, because many of the liquid and gaseous anaerobic decomposition products, carried to the surface by mixing currents, are utilized by the aerobic organisms. Stabilization lagoons, also called facultative lagoons, have been used to provide seasonal and continuous nitrification of wastewater.

Intermittent Discharge:

Facultative lagoons are usually used and operated in series. Sufficient capacity is planned so that all the wastes can be held in the lagoon for a period of six months to one year. During the spring and/or fall period, and after the lagoon contents have stabilized, the final cell in the series arrangement is isolated from the preceding cells. This insures no subsequent short circuiting of any raw sewage for this period of time. The level of dissolved oxygen is measured in the final cell and in the stream along with the volume of flow in the stream. When all conditions are considered correct, the effluent line to the receiving water is opened and the contents of the final cell are discharged over a period of two weeks to one month. Intermittent discharge lagoons can be used to meet secondary effluent standards.

Secondary Treatment-Filtration

Intermittent Sand:

Intermittent sand filtration is a process in which wastewater is intermittently applied to a sand filter. After passing through the filter media, the effluent is collected in an underdrain system. Periodically, the filter media will become clogged with trapped particles. At this time the top surface of the filter is raked and/or replaced, and the cycle repeated. Intermittent sand filters require considerable land area and are therefore primarily used in rural areas where land is cheap. Intermittent sand filtration can also be used as a polishing

process to upgrade existing wastewater treatment facilities.

Secondary Treatment-Physical-Chemical

Independent Two-Stage Lime Coagulation:

In the physical-chemical treatment process, lime is added to the raw wastewater in two stages to reduce the level of suspended organic solids and soluble phosphates. In the first stage sufficient lime is added to raise the pH over 11 to remove the phosphorous as a calcium phosphate precipitate and to form calcium carbonate as a coagulant for suspended solids removal. In the second stage gaseous carbon dioxide is added to lower the pH to approximately 10 in order to remove the excess soluble calcium as a calcium carbonate precipitate. The quantity of lime to be added is largely a function of the raw wastewater alkalinity and generally fall in range of 300 to 400 mg/l of CaO for two-stage lime treatment. A large portion of this lime can be obtained from recovering the calcium in the sludge from the two clarifiers. The sludge is transported to a thermal regeneration facility where the calcium carbonate is decomposed to lime. The carbon dioxide from this thermal process, or another source of stack gases, can be used as the source of CO_2 in the second stage precipitation of calcium carbonate.

Polishing Techniques

Additional Secondary Sedimentation:

Secondary sedimentation is used to remove settleable and floating material from wastewater under quiescent conditions. Sludge is collected in a hopper at the bottom of the tank and scum is skimmed from the surface. Chemicals may be added to promote the precipitation of phosphorous compounds, BOD_5, and suspended solids. Design of secondary sedimentation tanks is dependent on the type of biological treatment preceding it.

Additional secondary sedimentation is sometimes added to existing facilities to meet a more stringent effluent quality. This is basically accomplished because of the additional detention time and overflow rate provided, which makes a higher recovery of suspended solids possible.

Chemical-Polymer Addition to Secondary Clarifiers:

In certain processes solids may not flocculate and settle well in the secondary clarifier. This problem may become acute in plants that are overloaded. The addition of Al or Fe salts will cause the precipitation of metallic hydroxides and/or phosphates. Al and Fe salts, along with certain organic polymers will also destabilize colloidal particles. The resultant destabilized colloids and precipitates will settle readily in the secondary clarifier, reducing the effluent suspended solids, and affecting phosphorous removal.

Microscreens:

Microscreening is a physical straining process normally used to remove suspended solids from secondary effluents for polishing purposes. The process consists of a variable speed rotating drum mounted horizontally in a tank with two compartments. The influent enters the drum from one end and flows out radially through the filtering media attached to the drum's periphery. Backwashing is accomplished at the top of the drum where pressure jets of strained effluent are sprayed onto the screen to dislodge the accumulated solids. The solids flushed from the screen can be recycled to the head of the plant or conveyed to the sludge handling system.

Multi-Media Filtration:

Filtration is used in wastewater treatment as an intermediate or final polishing step for removal of suspended solids and will produce a small reduction in BOD_5. Additional phosphorous may also be removed if the wastewater is previously treated with alum. Multi-media filter beds have been composed of various combinations of anthracite, sand, garnet, and activated carbon. The process may require prechlorination to prevent buildup of biological growths on stationary components of filters. Backwash systems are required and high rate filtration may require a polymer feed system to contain breakthrough.

Immedium Filtration:

Immedium filters are primarily used in wastewater treatment as an intermediate or final polishing technique. Immedium filtration is a high rate upflow filtration process by which influent wastewater enters the bottom of the filter and flows upward through the filter bed. Backwashing involves pneumatic agitation of the media followed by washing, which expands the bed about 2 percent. Raw or filtered water can be used for backwashing because the filter is washed in the same direction as the flow.

Granular Carbon Absorption:

Activated carbon treatment of wastewater is usually used as a final polishing process. Wastewater is passed through a columnar bed of granular activated carbon where certain soluble organics are physically and chemically absorbed in the micropore structure of the carbon. Uusally, there is biological activity within the column which aids in the removal of both soluble and suspended organic material. Filtration of suspended solids can be achieved depending on the design of the carbon column. Backwashing facilities are needed and a regeneration system is required to remove the material absorbed on the carbon.

Powdered Carbon Absroption:

Powered activated carbon can be added to biological treatment effluents as a polishing process. The carbon can be added directly to the secondary clarifier or to a separate contact basin. Soluble organics are removed by both absorption and biological processes on the carbon surface. Since the carbon is very fine, a coagulant may be needed to aid in the removal of carbon particles, or filtration may be required; a regeneration process has not yet been developed for powdered carbon.

Tertiary Two-Stage Lime Coagulation Filtration:

The two-stage lime coagulation-filtration process, as previously described under secondary treatment, can also be used as a tertiary polishing technique that will appreciably reduce the BOD_5 suspended solids and phosphorous concentration.

Upgrading Lagoons

Recirculation Pumps:

Recirculation pumping to upgrade lagoons involves interpond and intrapond recirculation as opposed to mechanical mixing in the pond area. The effluents from pond cells are mixed with the influents to the cells. In intrapond recirculation, effluent from a single cell is returned to the influent to that cell. In interpond recirculation, effluent from one pond is returned and mixed with influents to another pond. Both methods return active algae cells to the feed area to provide photosynthetic oxygen to satisfy the organic load. Recirculation can affect stratification in ponds, and thus gain some benefit ascribed to pond mixing. Pond recirculation is not generally as efficient as are mechanical systems in mixing facultative ponds. The major advantages of recirculation are a decrease in the organic loading and prevention of odors and anaerobic conditions in the feed zone of the ponds. Recirculation is usually accomplished with high-volume, low-head pumps.

Aeration:

Aeration is used in upgrading lagoons to supplement the pond's photosynthetic oxidation capacity in instances where the pond must treat high seasonal BOD_5 loadings, or must operate under winter conditions, or where there is little room for expansion. This supplementation is usually achieved by installing compressed air diffusers or mechanical aerators. In addition to transferring oxygen to the liquid, aeration breaks up the thermal stratification that normally develops in oxidation ponds. The mixing derived from the aeration process tends to maintain aerobic conditions deeper in the pond. Aeration systems also serve to prevent odors usually generated in overloaded ponds.

Rock Filters:

Submerged rock filters have been proposed as a method of upgrading lagoons by reducing the algae which is often present in the final effluent. The filters are constructed of rock sizes greater than 2.54 cm. and less than 12.70 cm. A biological slime layer becomes established on the filter media and as the wastewater flows through the filter horizontally, the suspended solids are absorbed by the biological growth. During part of each year the biological slime layer will function in an anaerobic environment. Therefore, an aeration facility for the filter effluent will be required. The rate of solids accumulated in the filters is very slow making the effective life of the filter approximately 20-30 years.

Flotation-Clarification:

Flotation-clarification is a means of algae removal used in upgrading lagoons. Separation depends on the formation of fine bubbles that are physically attached to the algae causing them to float to the tank-water surface where they are collected and removed. Chemical coagulation enhances the removal. It is the algae-bubble-chemical matrix that is desired for good flotation, rather than large aggregates of chemically bound algae needed for sedimentation. No mechanical flocculation step in provided in flotation. Two modes are available for the formation of the fine bubbles; dissolved-air flotation and autoflotation. In dissolved-air flotation, a portion of the effluent or influent is pumped to a pressure tank where the liquid is agitated in contact with high-pressure air to supersaturate the liquid. When this pressurized stream is released into the influent, fine air bubbles are formed. These bubbles are then coagulated with the algae cells by the rapid addition of chemicals. The algae-chemical-bubble float is then removed at the surface of the tank. Autoflotation differs only in that no pressurization is required for the formation of the fine bubbles.

Seasonal Nitrification

Roughing Filter:

Roughing filters are fixed film biological systems in which a microorganism population develops on the wetted surfaces of the media. Roughing filters have been used ahead of conventional secondary treatment for reducing unusually high influent BOD_5 concentrations. In the seasonal nitrification application the purpose of the process is to reduce the organic load so that a downstream biological process will dependably nitrify the waste during the summer months.

Conventional Activated Sludge:

The conventional activated sludge process, as previously described under secondary treatment, can be used to provide seasonal nitrification of wastewater effluent at conservative design loading rates.

Low-Rate Trickling Filter:

A conservatively designed low-rate trickling filter process, as previously described under secondary treatment, can provide seasonal nitrification with low organic loadings.

Continuous Nitrification

Chemical Addition to Primary Treatment:

The additional BOD_5/SS removals afforded by chemical additions to primary treatment may solve overloading problems on downstream biological systems, or may allow nitrification - either seasonal or continuous, depending on the biological system designs. High pH primary effluents are amenable to NH_3 removal by ammonia stripping.

Suspended Growth:

In a controlled environment, certain microbial population will convert ammonia to nitrate in the presence of oxygen. Nitrosomonas act on dissolved

ammonia to form nitrite, which in turn is converted to nitrate by Nitrobacter. This process is carried out in the activated sludge system downstream from conventional secondary treatment or primary treatment with chemical additions. The oxidation of ammonia to nitrate can be carried out with either air or pure oxygen. Because the microbial conversion causes a drop in pH, provision should be made for lime or caustic addition with low alkalinity wastewaters.

Extended Aeration Activated Sludge:

The extended aeration activated sludge process, as previously described under secondary treatment, can be used to provide seasonal or continuous nitrification of wastewater effluent of conservative design loading rates.

Oxidation Ditch Activated Sludge:

The oxidation ditch activated sludge process, as previously described under secondary treatment, can be used to provide seasonal or continuous nitrification of wastewster effluent at conservative design loading rates.

Second-Stage Trickling Filter:

Second-stage trickling filters have been utilized to obtain seasonal and continuous nitrification. Two trickling filters are operated in series with an intermediate clarifier between them. The first stage filter operates as an ordinary trickling filter and consumes most of the organic loading. When the wastewater reaches the second-stage filter the organic loading is very low and this allows autotrophic nitrifying bacteria to form on the filter media. These bacteria convert the ammonia present in the wastewater to nitrites and nitrates. The well-nitrified effluent reduces the total oxygen demand in the receiving water.

Rotating Biological Contractors:

The rotating biological contractors process, as described under secondary treatment, can also be used if properly designed to provide seasonal or continuous nitrification.

Intermittent Sand Filtration:

The intermittent sand filtration process, as previously described under secondary treatment, can be used to provide seasonal or continuous nitrification.

Facultative Lagoon:

Facultative lagoons have been used to provide seasonal and continuous nitrification of wastewater. For a description of the biological process involved, see Low-Rate Stabilization Lagoons under secondary treatment.

Nitrogen Removal

Breakpoint Chlorination:

When chloride gas is added to wastewater containing nitrogen in the ammonia form, hypochlorous acid reacts with ammonia to produce chloramines. Further addition of chlorine to the breakpoint converts the chloramines to nitrogen gas. The reactions involved are dependent on pH, temperature, contact time, and initial chlorine to ammonia rates. A pH control system is usually necessary. Air may be added to the reaction chamber to aid in mixing and to strip nitrogen trichloride, carbon dioxide, and nitrogen gases from solution. Due to toxicity, dechlorination often accompanies this process.

Ammonia Stripping:

Ammonia stripping involves the conversion of NH_4+ ions to dissolved NH_3 gas by raising the pH of the wastewater to 10.8-11.5. The ammonia is then removed from solution by providing air-water contact in stripping towers or ponds.

Selective Ion Exchange:

Certain natural zeolites will selectively remove ammonia from solution. This process is carried out in columnar reactors of either the gravity or pressure flow type. When a column's removal capacity is exhausted, the resin is regenerated.

Suspended Growth Denitrification:

Nitrogen in the form of nitrates can be converted to nitrogen gas by bacterial populations in the absence of oxygen. This process is carried out in a plugflow activated sludge system following any process that converts ammonia and organic nitrogen to nitrate (nitrification). The bacteria obtain energy for growth from the nitrate-nitrogen reaction, but require an external source of carbon for all synthesis, because nitrified effluents are usually low in carbonaceous matter. Methanol is commonly used as a carbon source, but nutrient poor industrial wastes have also been employed. Nitrogen gas formed in the denitrification reaction will hinder mixed liquor settling. Therefore, a nitrogen gas stripping reactor should precede the denitrification clarifier. Polishing of residual methanol-induced BOD_5 is an added benefit of the stripping tank.

Fixed Film Denitrification:

Nitrogen in the form of nitrates can be converted to nitrogen gas by bacterial populations in the absence of oxygen. This process is carried out in a columnar reactor containing stone or synthetic media size, this process may not need to be followed by a clarifier, as in the conventional trickling filter system. Adequate solids wasting occurs through the low level suspended solids carry-over in the effluent. Periodic backwashing and/or air scouring is necessary to prevent solids buildup in the column that can cause excessive head loss. As in the suspended growth denitrification system, an external carbon source is necessary; methanol is commonly used, and nutrient poor industrial wastes are potential carbon sources. Most applications

of this process involve the downflow mode (either gravity or pressure), an expanded bed (upflow) technique has been tested.

Phosphorous Removal

Independent Physical-Chemical Two-Stage Lime Coagulation:

The physical-chemical two-stage lime coagulation process, as described under secondary treatment, can be used to obtain phosphorous removal from wastewater effluents.

Chemical Addition to Primary Treatment:

Chemical addition to primary treatment can be used to obtain phosphorous removal from wastewater effluents.

In the chemical addition process, ionic forms of Ca, Fe, or Al are added to raw wastewater. The Fe or Al react with the soluble orthophosphorous to produce a precipitate. When lime is used, both the Ca and OH react with the ortho-P to form an insoluble hydroxyapatite. Organic phosphorous and Polyphosphate are removed by more complex reactions and by absorption onto floc particles. The insoluble phosphorous, as well as considerable BOD_5 and suspended solids, are removed from the system as primary sludge. Violent mixing and flocculation are necessary upstream of the primaries. Addition of polymers may be required to aid in settling. A base is sometimes necessary in low alkalinity waters to keep the pH in the 5-7 range with mineral addition. Lime recalcination will lower chemical costs, but is a feasible alternative only for larger plants. Phosphorous removal with lime is limited to about 30 percent because the higher pH levels required for more efficient removal are inhibitory to biological systems. Therefore, recarbonation may be required if high phosphorous removals are to be accomplished in the primaries and followed by biological systems.

Metal Salt Addition to Secondary Treatment:

Metal salts are added to the raw wastewater, activated sludge aeration tank, or to the final clarifier influent channel. With trickling filter systems, the salts are added to the raw wastewater or the filter effluent. Multipoint additions have been successful. Phosphorous is removed from the liquid phase through a combination of precipitation, absorption, exchange, and agglomeration and it is wasted with the primary and/or secondary sludges. The use of lime or ferrous salts is limited because they produce low phosphorous levels only at high pH's which are not compatible with biological treatment. Improved settling and lower effluent BOD_5 results from chemical addition, particularly if polymers are also added to the final clarifier.

Biological-Chemical:

This process utilizes both biological and chemical removal mechanisms to effect phosphorous removal with considerably reduced chemical usage than that of chemical addition methods. This process is only applicable to treatment plants that use the activated Sludge form of secondary treatment.

The system consists of three major process steps; 1) Primary effluent enters the aeration tanks where biological absorption of the dissolved phosphorous in the wastewater is accomplished by the phosphorous deficient micro-organisms present; 2) The return sludge from the final clarifiers is introduced to an anaerobic stripping tank, similar to a gravity thickener, prior to recirculation to the aeration tank. Under anaerobiosis the microorganisms release the absorbed phosphorous to the supernatant and renders the return sludge to the aeration tanks devoid of phosphorous. The return sludge is then available to repeat the cycle; 3) The concentrated supernatant is treated with lime and returned to the primary clarifiers where the chemical sludge settles out with the primary sludge.

Land Disposal

Irrigation:

Irrigation is the most common land application technique and involves the application of primary or secondary effluent to the land for treatment and to aid the growth needs of plants. The wastewater is treated by physical, chemical, and biological means through interaction with the soil and plants. Effluent can be applied to crops or vegetation either by spraying or surface techniques for purposes such as avoidance of surface discharge of nuitrients; economic return from use of water and nutrients to produce marketable crops; water conservation; or preservation and enlargement of greenbelts and open space.

Infiltration-Percolation:

Infiltration-percolation consists of the application of effluent to the soil by spreading in basins or by spraying. Treatment occurs as the water percolates through the soil matrix. Because application rates are high, porous well-draining sand soils that function as natural filters are required. Infiltration-percolation systems can be designed for groundwater recharge; natural treatment followed by pumped withdrawal or underdrains for recovery; or natural treatment with renovated water moving vertically and laterally in the soil and recharging a surface watercourse.

Overland Flow:

In this method of land application wastewater is sprayed over the upper reaches of sloped terraces and allowed to flow across the vegetated surface to runoff collection ditches. Renovation is accomplished by physical, chemical and biological means as the wastewater flows in a thin sheet down the relatively impervious slope. It is essentially a biological treatment process with a minimum contact time between bacteria and wastewater required for adequate treatment.

Reaeration

Hydraulic:

Hydraulic aeration or cascade aeration is a post-aeration process which is used to increase the dissolved oxygen content of wastewater effluent. The plant effluent passes over a series of steps or weirs, at the base of which air is entrained and dissolved in an amount which is related primarily to the height of the fall.

Diffused Aeration:

Diffused aeration for reaeration increases the dissolved oxygen content of the effluent stream by bubbling compressed air into it through porous or nonporous media. Nonporous diffusers of the nozzle, orifice, and valve type release larger bubbles than porous diffusers. The design of the blowers is based on the static head of the liquid above the diffusers and at the distribution losses. Plugflow is desirable as it promotes efficient performance of the diffused air reaeration process. Variations from established plugflow, in some instances, could lower this efficiency.

Mechanical:

Mechanical aeration for reaeration increases the dissolved oxygen content of the effluent stream by creating turbulence and constantly changing the air-water interface. The design of mechanical aerators for aeration is based on the power required to produce the needed standard oxygen transfer rate. The actual horsepower required varies with the flow characteristics assumed in the reaeration basin. Complete mixing is usually assumed as it will result in a design which assures adequate oxygen distribution. Mechanical aeration can be accomplished in chlorine contact chambers. This eliminates additional land requirements and the construction of separate reaeration tanks.

Disinfection

Chlorine:

Chlorine is perhaps the most commonly used chemical disinfectant. As it is added to the effluent, readily oxidizable substances and organic matter react with the chlorine, reducing most of it to the chloride ion. After meeting this immediate demand, the chlorine will continue to react with the ammonia to form chloramines. With continued addition of chlorine, essentially all of the chloramines will be oxidized. Continued addition of chlorine will result in a directly proportional increase in the free available chlorine.

Hypochlorite:

Hypochlorite salts have also been added to wastewater effluent for disinfection. Sodium hypochlorite and calcium hypochlorite are the most commonly used. Once the salt disassociates, the reactions that take place are the same as for disinfection with chlorine. The use of hypochlorite salts for disinfection has increased during the past few years as a result of shortages and price escalation of liquid chlorine.

Ozone:

Ozone is used in the disinfection of wastewater effluent. Ozone is applied by mixing ozonized air with the water being treated. Organic matter in water has an ozone demand that must be met before the excess becomes available for germicidal activity. Once this demand has been satisfied, bactericidal action is very rapid. The higher the concentration of ozone the more rapid the disinfection. Ozone does not persist as a residual bactericide, but rapidly breaks down in water to oxygen. Due to lack of residuals there is no certainty of completion of disinfection and there remains the possibility of potential contamination once the initial demand is met. Ozone purification also reduces odor problems.

DISPOSAL OF TREATMENT PLANT RESIDUALS

Introduction

The various sources of treatment plant residuals and the amount of residuals produced are dependent on several factors including type of treatment, type of collection system (i.e., separate or combined sewers) and the efficienty of plant operation.

Total solids reduction by a treatment plant or device is indicative of the efficiency of the process. Total solids entering the plant may be broken down into volatile and fixed matter. It is generally assumed that the volatile portion represents the organic matter and is indicative of the "strength" of the wastewater. The organic portion will begin to putrify after a period of several hours. Fixed solids have little significance.

Settleable solids in wastewater are those solids that are removed by plain sedimentation, the efficiency of the sedimentation process has a direct bearing on the sludge forming characteristics of the wastewater.

With respect to wastewater, the first point of generation of treatment plant residuals generally occurs in the screening process. Two types of screening may be used; (1) coarse screens and (2) fine screens. Coarse screens are utilized for removal of the larger particles of floating or suspended matter. These devices are used to prevent clogging of sewer channels and treatment plant units to prevent injuries to equipment. Fine screens frequently take the place of sedimentation where insufficient space is available for sedimentation tanks. This latter method is rarely used in modern day practices in Kentucky.

In the larger wastewater plants, coarse screens and grit chambers are integrated into one unit. The amount of screenings removed depends upon the character of the wastewater and the screen spacing. This amount may vary between 0.5 and 50 cubic feet per million gallons of wastewater treated. Before drying, screens contain 75 to 90 percent moisture and weigh 40 to 60 pounds per cubic foot. On a dry weight basis, the screenings vary between 10 and 400

weigh 40 to 60 pounds per cubic foot. On a dry weight basis, the screenings vary between 10 and 400 pounds per million gallons and consists of fecal matter, paper, rubber, plastics, cloth, particles of food and other putriscible and non-putriscible material that requires prompt removal and disposal.

Grit chambers or other grit removal devices are often built in conjunction with bar screens. Generally, grit removal equipment is designed to remove the heavier inert solids such as grit and sand of a size of approximately 0.2 millimeters. Numerous factors affect the amount of grit that may be collected and removed from the wastewater flow. In theory, grit should not be expected in separate sanitary sewers; however, in practice it has been found that grit does enter the collection system somehow. In combined sewers draining steep unpaved streets, a heavy accumulation of grit may be expected. Thoman (78) has reported a variation of grit accumulation in combined sewers from 0.5 to 10.0 cubic feet per million gallons of wastewater flow and 0.76 to 4.8 cubic feet in separate sewers.

Grit taken from grit chambers or other devices will contain considerable organic matter. This material must be rapidly and efficiently disposed of, usually by burial, otherwise putrification will take place, causing odors and breeding habitats for rodents and insects. Screenings may also be removed from the wastewater flow and burried along with the grit. Many plants are designed to shred the screenings with subsequent return to the wastewater flow where they are removed by other plant units. Returning screenings to the wastewater flow often results in other problems within the plant, often causing stoppages in equipment and digesters.

Another residual source of solids from treatment plants involves sedimentation basins. These are usually constructed on a continuous-flow basis and may either be rectangular or circular in design. Most, if not all, present-day sedimentation tanks are equipped with mechanical sludge collecting facilities for efficiency of operation at minimal cost.

The results of the sedimentation process may be expressed as a percentage or removal of BOD and suspended solids. Characteristically, sedimentation basins may be expected to remove 25 to 50 percent of the BOD and 50 to 65 percent of the suspended solids depending on tank design and wastewater characteristics.

Solids that are removed by sedimentation are usually transferred to either an aerobic or anaerobic digester for further processing. The percent of solids recovered from the primary settling tanks may be expected to be about 5 percent on a dry weight basis. Thickening of sludge prior to deposition in the digesters will increase this percentage of solids on a dry weight basis. The percentage increase will be dependent upon characteristics of the waste, thickner loading and design and operational efficiency.

Other sources of wastewater plant residuals include waste activated sludge from biological systems, or trickling filters that are collected in secondary sedimentation tanks. In the event the return activated sludge is not needed for "seeding" of the incoming wastewater, it is wasted to the primary sedimentation tanks for simultaneous collection with the raw or primary sludge and disposed of directly to aerobic or anaerobic digesters with or without prior thickening. Waste activated sludge is often handled separately and pumped directly to the digesters.

The use of vacuum filters, traveling belts, screens and centrifuges may also be used for handling raw primary or mixed primary and secondary waste activated sludge without digestion.

Typical suspended solids concentrations in sludges from the treatment of domestic wastewater follows:

Type of Sludge by Treatment	Suspended Solids (Percent of Weight)
Primary Sludge	
Fresh	2.5-5
Thickened	8-10
Digested	10-15
Chemical Precipitation	
Fresh	2-5
Digested	10-15
Trickling Filter	
Fresh	5-10
Thickened	7-10
Primary and Trickling Filter	
Fresh	3-6
Thickened	7-9
Digested	10-15
Activated Sludge	
Fresh	0.5-1
Thickened	2.5-3
Digested	2-3
Primary and Activated Sludge	
Fresh	2-5
Thickened	5-10
Digested	6-8

The three primary types of sludges produced by sewage treatment works are:

(a) Primary sludge, which consists of the residue that has settled out in primary sedimentation basins, on the average the amount of primary sludge approximates 0.125 lbs. of dry solids per person per day. This amount can vary greatly from plant to plant depending on the efficiency of the system and the characteristics of the influent wastewater.

(b) Humus sludge, consists of solid matter settled out of the effluent of trickling filters. This sludge, with a moisture content of 94-97% is rather difficult to dewater and is produced at the approximate rate of 0.029 lbs. of dry humus per person per day.

(c) Waste activated sludge is the surplus sludge produced in an activated sludge plant. This sludge has a moisture content of 98-99.5% water and is extremely difficult to dewater. The dry sludge contains 5-7% nitrogen and 2-4% phosphorous. Activated sludge plants produce very large volumes of sludge, thus creating difficult disposal problems.

In general, the volume of sludge is small in comparison to the volume of wastewater treated. The original sludge from a typical activated sludge plant averages approximately 6% of the total flow and this figure is reduced to 1% by thickening then to 0.2% by drying.

However, the costs of treatment and disposal of sludge does comprise a major part of the total cost of the sewage treatment process, usually 20-50% and the fraction of total waste treatment cost attributed to sludge treatment and disposal increases with plant size.

Alternatives in Sludge Management

In most cases it is not feasible to return sludges directly to the water, or onto land. Therefore, additional treatment must be provided. The goal of sludge treatment is to reduce the volume of sludge or alter its nature in a manner to render it inoffensive and prevent the creation of public health hazards. To accomplish these goals a variety of treatment techniques are employed; (i.e., thickening, digesting, dewatering, drying, and incineration prior to disposal).

One or more of the following discussed methods are utilized for in-plant handling of sludge.

(1) Thickening - The first step in the removal of unwanted moisture in sludge may be accomplished by either a gravity or flotation thickening process. For gravity thickening, the sludge is fed into a settling tank, and allowed to stand for a specified period of time to permit the solid particles to settle so that the supernatent liquid may be drawn off and returned to the plant influent.

To accomplish thickening by flotation, fine air bubbles are blown through the liquid sludge, which adhere to the solids, thereby increasing their buoyancy. This process causes the solids to float to the top so that skimming may take place. Obviously, air generation for the flotation thickening is more complex and costly than gravity thickening. In general, this type of thickening process is employed only at the larger installations.

(2) Vacuum Filtration - Historically, vacuum filtration has been the most commonly used mechanical method for sludge dewatering in this country at the larger plants. A sludge of very low moisture content may be produced by the process of applying a suction or vacuum to sludge material, thereby drawing off the supernatant liquid.

Many types of filters are commercially available; however, they are all complex in nature and the treatment plant must be large in order to justify the increased cost and operational problems involved.

(3) Filter Pressing - Manual or automated filter presses dewater sludge cheaply and give a lower moisture content to the resulting sludge than most other methods. It is efficient regardless of weather conditions and the press cake is quite lucrative for use as a soil conditioner for agricultural land. The presses work by physically condensing the material to a much smaller volume and forcing the water out through tiny openings in the press plates. The resulting sludge has a moisture content of approximately 30 to 50 percent. As in other dewatering operations, the separated liquors are highly polluting and must be returned to the influent of the treatment plant.

The filter press is an alternative to sludge drying beds, particularly where site conditions are limited.

(4) Centrifuging - The use of a centrifuge as a process for separation of water from sludge solids has been used for many years, but there have been very few applications due to their ineffectiveness. The most feasible application is a cylindrical-conical type of centrifuge. Sludge is introduced through a hollow shaft into the centrifuge that revolves at a high speed. Centrifugal force causes the sludge solids to consolidate at the outer centrifuge wall. Recent improvements have been made in this process of sludge separation.

Other lesser known methods of sludge dewatering have been used and other methods are being continually developed. The most common method used for dewatering digested sludges has been the use of sand drying beds. These will be discussed later in this chapter.

Digestion

Dewatering may occur prior to or subsequent to digestion of the organic material. Two general methods of digestion are anaerobic digestion and aerobic digestion. A discussion of these methods follow:

(1) Anaerobic Digestion - Although sludge undergoes digestion by anaerobic bacteria when stored for long periods of time, the process is extremely slow under normal conditions, often requiring three to six months. By heating the sludge in the large digestion tanks the process of digestion can be completed more rapidly. Usually a two stage process is utilized in which the sludge is heated for 7 to 30 days at 27 to 35 degrees C. in a primary digester. Most of the digestion process and gas evolution takes place in this first stage. The sludge is pumped to a secondary digester where the digestion process is completed at ambient temperatures in 10 to 60 days.

Digestion reduces the organic contents of the original sludge. The chief by-product of the digestion process is methane gas that is often used to heat the first stage of the process and other energy needs such as heating of plant buildings.

(2) Aerobic Digestion - The organic material in sludges may also be reduced by aerobic treatment. The results of aerobic digestion are similar to those of anaerobically digested sludge in that the end products of both are inorganic solids, comparatively inert organic solids and materials in the liquid phase.

The complex operational problems that are prevalent in anaerobic digestion do not exist in aerobic digestion, however, oxygen must be generated for aerobic organisms and this is an expensive process. Also, energy recovery from methane is not possible.

Combustion

In larger plants, it is often more economical to burn the raw sludge subsequent to dewatering than to operate many large digestion facilities . Raw sludge has a much higher organic content than digested sludge and, therefore, the heat value is greater and will burn more readily.

Three primary types of sludge incinerators are multiple hearth, rotary drum and fluidized bed. A brief discussion of each follows:

(1) Multiple Hearth - This consists of a number of perforated hearths set one above another. The sludge is fed in at the top and passes downward as the combusted gases flow in an upward direction.

(2) Rotary Drum - This consists of a rotating steel cylinder with one end higher than the other. The sludge is entered at the higher end and after it is incinerated both the gases and ash are expelled at the lower end.

(3) Fluidized Bed - In this type of incinerator the sludge is fed onto a bed of heated sand which is agitated by forced air upward through the bed. The ash and gases then pass upward through a cyclone separator.

Combustion is an expensive process and until recently did not take advantage of the heat value of the sludge. More consideration is now being given to raw sludge as a source of energy. The products of combustion must be disposed of generally by burial, often in sanitary landfills. Air pollution control equipment is normally required on incinerators to prevent air pollution.

Ultimate Disposal

None of the methods discussed to this point results in complete and final disposal of all sludge constituents. Ultimately all parts of the sludge must return to the environment and more specifically to the land, water or air.

(1) Disposal to Air - Biological and thermal decomposition of sludge result in disposal of resulting gases to the atmosphere. These gases consist mainly of carbon dioxide and water vapor which have no adverse effects on the environment. However, the air is not a satisfactory medium for disposal of many gaseous products and particulate matter given off as the result of incineration.

(2) Disposal to Water - The only major constituent of sludges that is not out of place in the environment is water. However, the water that is removed in the thickening and dewatering processes must be treated prior to being discharged to water courses. Therefore, ultimate disposal of sludges to fresh water is not an alternative.

(3) Disposal to Land - From the previous discussions it is clear that part or all of the sludge generated at treatment plants must be returned to the land. The two most common methods of application are disposal of sludges in mines, quarries and landfills; or applying sludge to the land as a soil conditioner for increased plant growth. Many waste sludges such as those produced by biological treatment of organic waste are beneficial to the soil and will increase the productivity of crops. Ecomomically the use of sludge as a fertilizer has not been able to compete with the convenience and precise control of commercial fertilizers. Land disposal of sludge should be viewed as a method of returning a natural resource to the land. The sludge from municipal plants is usually deficient in potash which is necessary for proper plant development; however, sludge has agricultural value. It may be applied to the soil in liquid form, dewatered form or dried form. If applied in the liquid form it serves additionally as a source of irrigation and saves on treatment costs since dewatering is not necessary; however, transportation costs are greatly increased due to the much greater volume. All of these factors must be weighed in selection of the appropriate sludge disposal method. Great care must be exercised in the selection of a disposal method to prevent the creation of health hazards or additional pollution by runoff into adjacent streams.

Exhibit 4.12t

Projected Sludge Disposal Needs

County	Population (1980)	Sludge * (Cu.Ft./Day)	Number of Licensed Disposal Sites and Permit No.	Capacity (Cu.Ft.)
Anderson	1,317	13.2	(1) 003.01	
Bell	1,137	11.4	(1) 007.03	
Boone	903	9.0	(3) 008.01; 008.03; 008.04	
Boyle	16,698	167.0	(3) 011.05; 011.08; 011.09	
Breathitt	14,830	148.3	(2) 013.01; 013.03	
Carroll	7,438	74.4	(2) 021.04; 021.06	
Casey	92	0.9		
Clark	6,761	67.6		
Clay	16,549	165.5		
Estill	13,886	138.9	(1) 033.02	
Fayette	214,352	2143.5	(3) 034.04; 034.05; 034.06	
Franklin	39,648	396.5	(2) 037.04; 037.05	
Gallatin	1,169	11.7		
Garrard	9,848	98.5	(1) 040.01	
Grant	8,665	86.7	(1) 041.02	
Harlan	3,931	39.4		
Henry	7,927	79.3	(2) 052.04; 052.02	
Jackson	4,979	49.8		
Jessamine	22,000	220.0	(1) 057.02	
Knott	11,036	110.4		
Knox	2,341	23.4	(2) 061.04; 061.05	
Lee	6,378	63.8		
Leslie	12,342	123.4		
Letcher	18,485	184.9	(1) 067.06	
Lincoln	12,262	122.6	(1) 069.04	
Madison	50,118	501.2	(3) 076,02; 076.04; 076.06	
Menifee	1,350	13.5		
Mercer	4,183	41.8	(1) 084.05	
Montgomery	1,660	16.6	(3) 087.01; 087.03; 087.04	
Owen	7,564	75.6		
Owsley	4,999	50.0		
Perry	24,441	24.4	(1) 097.06	
Powell	8,850	88.5		

* Twenty percent solids by weight.

Exhibit 4.12t

Projected Sludge Disposal Needs

County	Population (1980)	Sludge * (Cu.Ft./Day)	Number of Licensed Disposal Sites and Permit No.	Capacity (Cu.Ft.)
Rockcastle	1,623	16.2	(1) 102.03	
Scott	19,608	196.1	(1) 105.01	
Shelby	2,648	26.5	(2) 106.01; 106.01	
Trimble	2,427	14.3		
Wolfe	5,663	56.6		
Woodford	17,057	170.6	(1) 120.03	

* Twenty percent solids by weight.

CHAPTER 5

BASINWIDE MANAGEMENT PLAN

INTRODUCTION

The Kentucky River Basin plan has been developed as a management document to meet the requirements of Public Law 92-500 and more specifically paragraph 303(e) which requires planning for the 1975-1995 time period. This plan is a data base for the identification of water quality problems which currently exist in the Kentucky River Basin. It also provides a mechanism for developing action priorities for the solution of these problems. The information that has been generated and set forth in this planning document should be used as a dynamic management tool. Future refinement and the addition of other data will continually enhance the plans value to the Commonwealth.

Refinement of existing data and the accumulation of additional data is imperative for implementation of long range planning. There are many informational gaps that need filling to effectuate water quality management. Additional water quality monitoring and surveillance are immediate basic requirements for developing planning effectiveness.

It was the consensus of river basin planning consultants that the successful management of Kentucky's streams, as it relates to water quality, could best be accomplished by integrating field and office operations in a manner that will permit maximum coordination. The degree of management success will largely depend on; (1) obtaining accurate field data, (2) developing working computer data bases, and (3) continually updating computer data bases utilized in River Basin Planning.

A discussion of the proposed central office organizational structure and related activities may be found in the Executive Summary.

To achieve the water quality goals for Kentucky's streams, it was the consensus of river basin planning consultants that field offices should be established on a basin or multi-basin area concept. Such field offices, to be effective, will require a multi-disciplinary staff, strategically located within the basin or multi-basin area to effectuate successful water quality management and cooperation with local units of government. Each field office will of necessity require extensive laboratory monitoring equipment to accomplish the following tasks within its designated area.

(1) Identify water quality problem areas.

(2) Coordinate 201 and 208 planning activities.

(3) Inspect wastewater facilities construction.

(4) Operate and maintain monitoring and surveillance network facilities

(5) Operate a mobile type monitoring station for "spot checking" potential water quality problem areas. The mobile monitoring stations will also provide the means to quickly assess the results of abatement programs on water quality.

(6) Establish and operate a regional laboratory for providing services to the smaller communities and for providing addition data to the Central Office for filling data gaps that presently exist.

(7) Provide other data and assistance to the Central Office for updating water quality management data, such as non-point source pollution problems.

(8) Assist in wastewater treatment plant operator training and certification.

(9) Review plans and specifications for wastewater treatment facilities to ascertain conformance with required treatment levels.

(10) Provide guidance and control during emergencies such as "accidental spills" and other unusual and unpredictable events that will undoubtedly occur.

(11) Coordinate water quality management planning at the basin level with other governmental and non-governmental agencies.

Field offices should be established with due consideration to travel time, problem sources and need for assistance to local communities. In the Kentucky River Basin consideration should be given to the location of the principal office in Richmond, Kentucky, with a sub-field office in Hazard.

Location of the principal field office in Richmond would have the advantage of being near a university and near the center of population of the basin.

A sub-field office in Hazard is needed because of the excessive distance to that area from Richmond and because of the severe water quality problems in the Eastern Coal Field that necessitates continuous surveillance.

The principal river basin field office should be under the supervision of a competent environmental

engineer supported by a highly technical staff. The basin engineer should report directly to the Chief of the Water Quality Division located in the Central Office at Frankfort.

BASIN PLAN

The process of segmentation and prioritization previously discussed in Chapter Four focuses attention to the critical water quality problem areas in the Kentucky River Basin. The Basinwide Management Plan (EXHIBIT 5.1m) graphically summarizes these problem areas. The priority number and rank in the basin is shown for each segment and each is color coded using a scale common for all River Basin Plans in Kentucky. Low priority segments (indicated in yellow) have a priority number of less than 200 because of their relatively minor water quality problems. Medium priority segments (indicated in orange) have a priority number between 200 and 1000; their water quality problems are more extensive and should receive close attention after the high priority segments (indicated in Red) have been studied and steps taken to improve their more serious water quality problems. In the basin the high priority segments are #12 (Frankfort), #16 (Georgetown), #17 (Lexington) and #31 (Danville). It should be noted that there is a direct relationship between the high priority segments and individual dischargers with critical needs.

The method for upgrading water quality within the Kentucky River Basin obviously requires additional treatment of wastewater discharges where water quality violations exist. Waste load characteristics of Water Quality Limited segments are presented in EXHIBIT 5.2t. Through the process of water quality modeling, total maximum daily loads (TMDL) in pounds per day of total oxygen demand (TOD) were calculated. The formula and terms are defined as follows:

Total Maximum Daily Load (TMDL)

TMDL = 8.34 x Q x TOD

Q is the 1980 discharge in million gallons per day (MGD)

TOD is the total oxygen demand in mg/l produced by the proposed treatment level as indicated below:

Treatment Level	TOD (mg/l)
T1	135
T2	98
T3	83
T4	20
T5	9

Example calculation:

Assumptions: Discharge from a 5MGD plant providing T-2 treatment.

TMDL = 8.34 x 5 x 98 = 4087 pounds per day

The TMDL represents the 1980 daily load to the stream in terms of pounds per day of total oxygen demand.

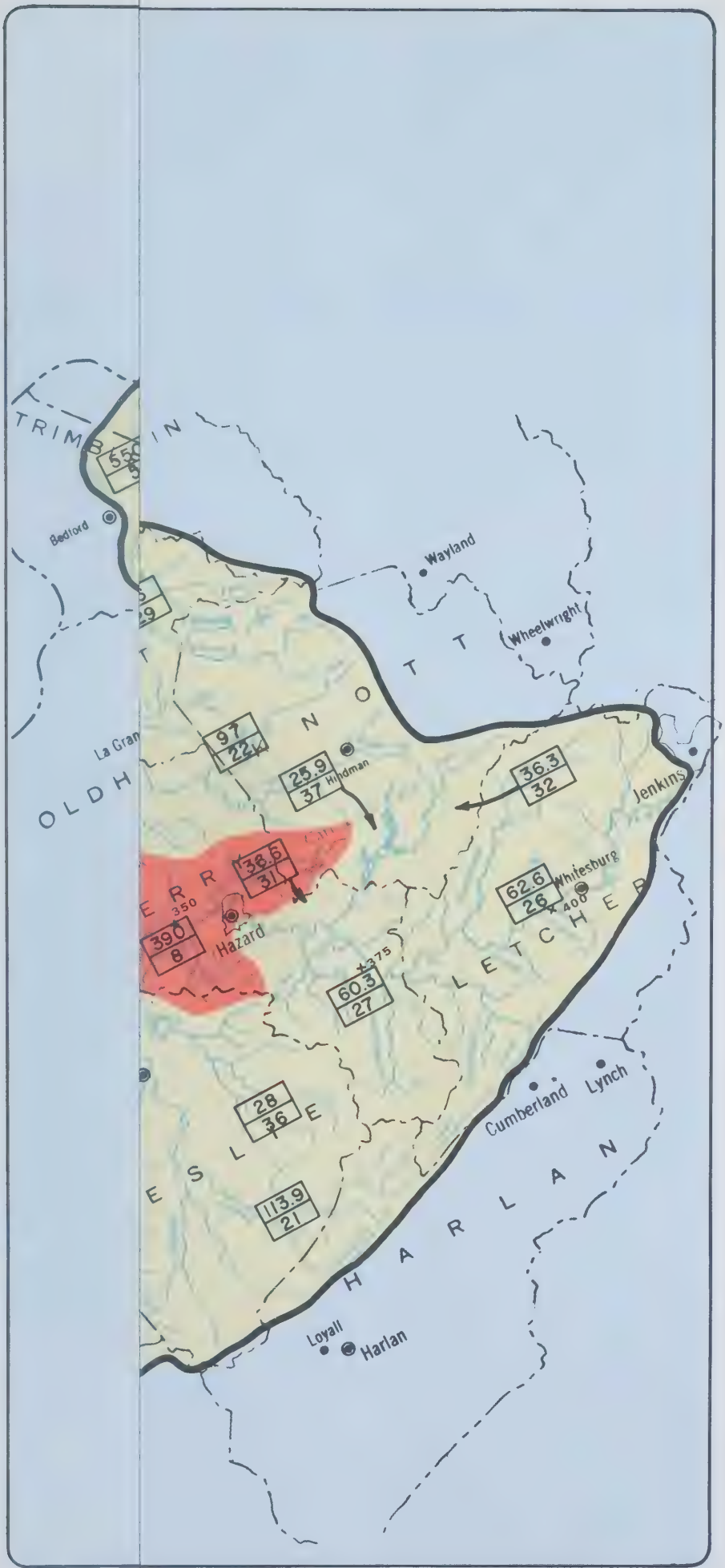
If more than one discharger was located in the segment, a separate calculation was made for each discharger. A summation of the results of all such dischargers equals the TMDL of the segment.

The maximum theoretical daily load (MTDL) was also determined. This term, MTDL, has been defined as follows:

EXHIBIT 5.2t Waste Load Characteristics of Water Quality Limited Segments

Segment Number	TMDL lbs./day TOD	MTDL lbs./day TOD	Segment Priority Number
007	2.0	671.3	3.5
008	9.2	23.6	2.7
009	58.9	385	35
010	140	155	83
011	27.1	170	93
012	3,653.5*	2,522.2*	4,600
016	236.7	9,038	1,200
017	2,812	17,642	4,950
018	106	690	190
025	1,660	12,500	212.5
026	38.5	135	67
027	171	1,140	390
028	225	225	495
031	525	1,851	1,325
032	52.7	546	170
033	53.4	350	120
034	80	884	380
035	193	2,024	160
049	10.4	10.4	56
050	30	212	97
051	58.6	223	231
053	2.0	2.0	28
058	0.0	0.0	36.3

***Segment #12 indicates the the total maximum daily load for 1985 is greater than the maximum theoretical daily load and implies that stream standards are violated. However, this is not the case. The waste load generated in Segment #12 is partially assimilated by the next segment down stream (the dissolved oxygen sag is spread over two segments) and consequently stream standards will not be violated. This has been validated by the Water Quality Modeling process.**



KENTUCKY RIVER BASIN

EXHIBIT 5.1m

BASINWIDE MANAGEMENT PLAN

LEGEND

- ⊢ 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- (16) SEGMENT NUMBER
- 56 / 31 SEGMENT PRIORITY NUMBER / SEGMENT RANK IN BASIN

SEGMENT PRIORITY (State wide)

- HIGH
- MEDIUM
- LOW

5 0 10 20

GRAPHIC SCALE IN MILES

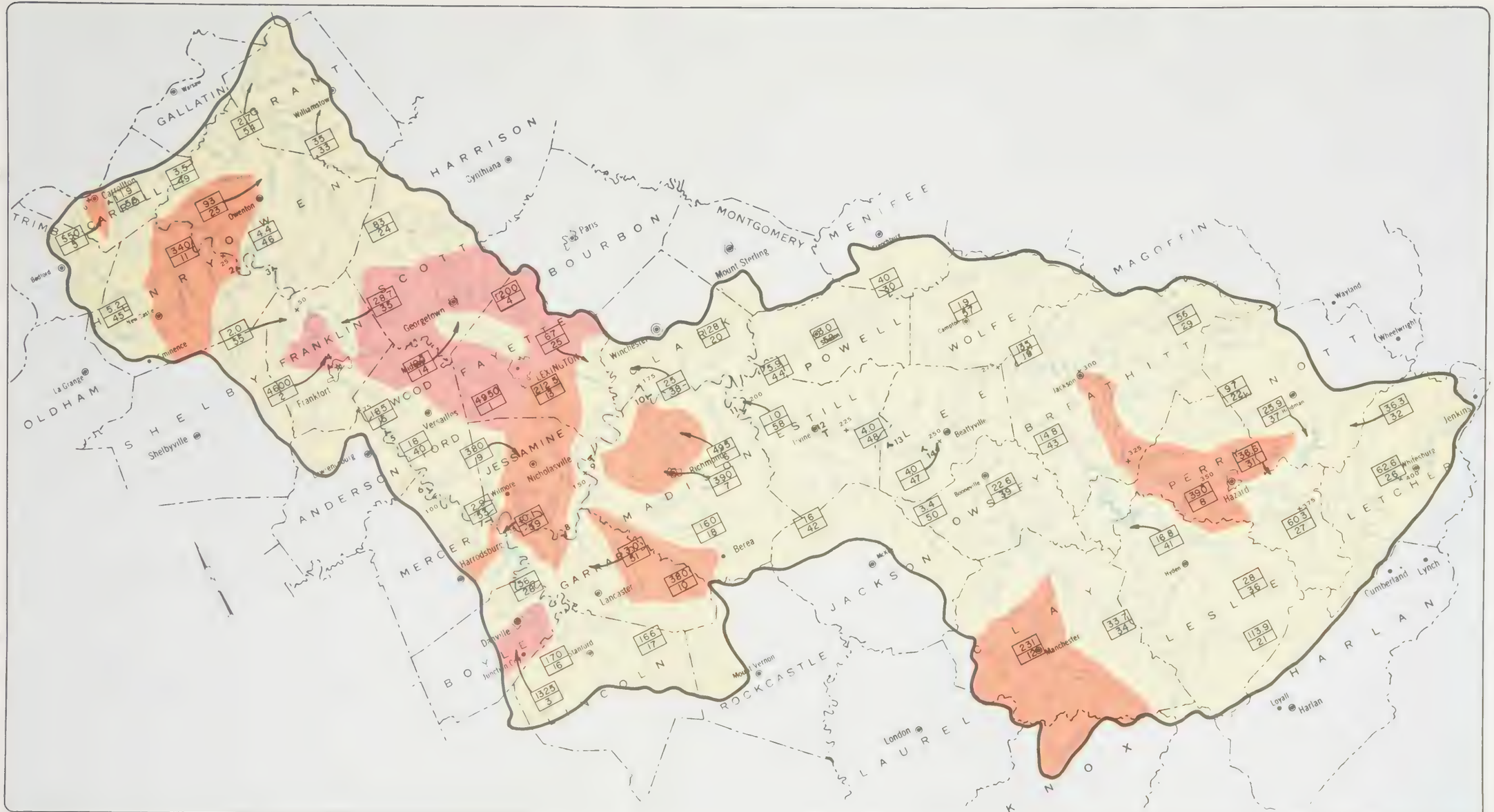
Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Miller, Wihry & Lee
INCORPORATED
Landscape Architects and Engineers
Landward House • 1387 South Fourth Street • Louisville, Kentucky



KENTUCKY RIVER BASIN

EXHIBIT 5.1m

BASINWIDE MANAGEMENT PLAN

LEGEND

- ⊢ 5 LOCK AND DAM NUMBER
- + 50 RIVER MILE
- (16) SEGMENT NUMBER
- 56 / 31 SEGMENT PRIORITY NUMBER / SEGMENT RANK IN BASIN

SEGMENT PRIORITY (State wide)

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- MEDIUM
- LOW

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data U S Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Miller, Wihry & Lee

INCORPORATED

Landscape Architects and Engineers

Maximum Theoretical Daily Load (MTDL)

MTDL = 17.2 KatQ

Ka is the reaeration factor determined by a computer output and varies from 0.0 to 0.65.

t is the time of travel through the segment.

Q is the average flow through the segment in cubic feet per second (cfs).

Example Calculation:

Assumptions: Ka = 0.2; t = 3 days and Q = 25 cfs

MTDL = 17.2 x 0.2 x 3 x 25 = 258 pounds per day.

This figure is the total daily assimulative capacity of the stream segment.

Basinwide needs for 1980 and 1995 are presented in EXHIBIT 5.3t for all significant (greater than 50,000 gallons per day) dischargers. The table includes the discharge priority number, code number assigned under this plan with the segment number in brackets, name of the facility, waste load allocation, compliance goals, treatment needs and approximate costs.

For all municipal dischargers the construction abatement priority has also been listed. This priority number will be used as a guide for the distribution of state and federal water quality improvement funds.

The discharge priority formula was developed as a cooperative effort by the Division of Water and the Federal Environmental Protection Agency using the following criteria:

(1) The priority of the segment in which the discharger lies (excluding metals, thermal, and non-point sources);

(2) The National interest;

(3) The "needs" survey;

(4) Status of 201 Facility Planning.

The discharge priority consists of a number followed by a capital A, B, or C and a lower case a, b, or c. The number is used to rank the discharger relative to other dischargers in the basin reflecting a greatest needs order. Subsequent to the priority number the capital letter, A, B, or C is assigned based on the population of the community involved as follows:

"A" - for a community in SMSA

"B" - for a community not in SMSA but having a population greater than 10,000

"C" - for a community with a population of less than 10,000

An additional lower case letter a, b, or c is assigned to designate the current state of the 201 planning process as follows:

"a" - Step No. 1 initiation

"b" - Step No. 2 initiation

"c" - Step No. 2 Completion

A more detailed explanation of the construction abatement prioritization process is presented in Chapter Four.

Each discharger has been assigned a treatment level necessary to maintain water quality in the receiving stream. The effluent parameters or compliance goals associated with the required treatment level are also shown in EXHIBIT 5.3t. For further explanation of these treatment levels see Chapter Four.

The last column of EXHIBIT 5.3t lists the approximate costs necessary for upgrading and improving the various municipal collection and treatment systems in the basin. Costs were divided into the following five types of needs: treatment needs costs (T), collection system costs (C), costs for new interceptors (I), elimination of Inflow/Infiltration (I/I), and costs associated with separation of combined sewers (CS).

It should be noted that these costs are a rough estimate only, and a more detailed and accurate determination of needs and their associated costs will be made available through the 201 Facilities Process.

Eutrophication of Lakes

A number of large impoundments exist in the Kentucky River Basin and others have been proposed for construction. Nutrients in the form of carbon, nitrogen, and phosphorous, which are present in domestic sewage may cause eutrophication. Eutrophication is a phenomenon in which the above mentioned nutrients stimulate the growth of algae and aquatic weeds. This produces aesthetically degraded waterways often typified by foul tastes and odors, widely varying dissolved oxygen concentrations, elevated pH, and a variety of undesirable secondary effects.

Lakes are a prime target for eutrophication because of their quiescent nature. Some flowing streams may also exhibit this problem. The long warm summers in Kentucky provide a climate in which, given all of the other essential ingredients, lakes may proceed through an aging process at an unusually rapid rate.

The answer to the control of this aging process clearly lies in the control of nutrients reaching the lakes. Growing cells need a variety of well balanced source of nurtients on which to thrive and multiply.

Exhibit 5.3t

Basinwide Needs for 1980 and (1995)

Discharge Priority	Code Number (Segment Number)	Facility	Non Conservative Waste Load Allocation lbs./day TOD	Compliance Goals 1980 - (1995)						Treatment Needs 1980- (1995)	Cost Million $ 1980
				Flow mgd	BOD mg/l	SS mg/l	NH3-N mg/l	DO mg/l	Other mg/l		
671 Ca	04001 (002)	Carrollton STP	472.9	0.42 (0.45)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	T - 0.6 C - 1.8 I - 0.5 I/I- 0.15
-	04002 (003)	General Butler State Park	78.8	0.07 (0.1)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	
885 Ca	04006 (004)	New Castle STP	30.0	0.18 (0.2)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.25 C - 0.2 I - 0.1 I/I- 0.05
-	04007 (005)	Geohagan and Mathis	-	0.3 (0.3)	- -	30.0 (30.0)	- -	- -	6-9 pH	BPT* BPT**	
44 Ca	04003 (009)	Williamstown STP	20.0	0.12 (0.15)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.4 C - 1.5 I - 0.3
-	04005 (010)	Delaplain Motel	33.36	0.2 (0.4)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	
261 Ca	04004 (011)	Owenton STP	23.4	0.14 (0.15)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.3 C - 0.2 I - 0.05 I/I- 0.08
5779 Ba	04023 (012)	Frankfort STP	5629.5	3.5 (5.0)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	T - 5.1 C -11.2 I - 3.6 I/I- 0.8
240 Ca	04025 (013)	Versailles STP	66.7	0.4 (0.55)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.5 C - 4.0 I - 1.0 I/I- 0.2
-	04026 (013)	National Distillers	563.0	0.5 (0.6)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	
-	04027 (014)	Kentucky Utilities-Tyrone	-	190.0 (200.0)	- -	- -	- -	- -		BPT* BAT**	
-	04028 (014)	Austin-Nichols	619.2	0.55 (0.6)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	
-	04029 (014)	Universal Button	-	0.16 (0.2)	- -	15.0 (15.0)	- -	8.0 (8.0)		BPT* BAT**	

* Best Practicable Control Technology Currently Available.
** Best Available Technology Economically Achievable.

Exhibit 5.3t

Basinwide Needs for 1980 and (1995)

Discharge Priority	Code Number (Segment Number)	Facility	Non Conservative Waste Load Allocation lbs./day TOD	Compliance Goals 1980 - (1995)						Treatment Needs 1980- (1995)	Cost Million $ 1980
				Flow mgd	BOD mg/1	SS mg/1	NH3-N mg/1	DO mg/1	Other mg/1		
-	04030 (014)	Kentucky Stone	-	0.052 (0.6)	- -	30.0 (30.0)	- -	- -		BPT* BAT**	
-	04024 (015)	Schenley Dist.	292.7	0.26 (0.3)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	
-	04009 (015)	Old Grand Dad	247.7	0.22 (0.3)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	
-	04008 (015)	Central Screw (C/W)	-	0.12 (0.12)	- -	- -	- -	- -		BPT* BAT**	
2112 Ca	04010 (016)	Georgetown STP	223.5	1.34 (1.5)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.8 C - 2.0 I - 0.5 I/I- 0.25
-	04014 (016)	U.S. Army Depot	10.8	0.065 (0.07)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	
7781 Aa	04016 (017)	Lexington STP #2	2532	15.0 (20.0)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 7.0 C -40.0 I -12.0 I/I- 3.2
196 Ca	04015 (017)	Midway STP	18.4	0.11 (0.13)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.55 C - 0.3 I - 0.1 I/I- 0.05
-	04063 (017)	Fed. Correction Institution	490.4	0.6 (0.6)	20.0 (20.0)	20.0 (20.0)	15.0 (15.0)	4.0 (4.0)		T2A (T2A)	
-	04017 (017)	South Elkhorn Service Co.	38.4	0.23 (0.32)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	4.0 (4.0)		T4A (T4A)	
-	04022 (017)	American Can Co.	-	0.13 (0.15)	- -	- -	- -	- -		BPT* BAT**	
-	04018 (017)	Monticello Estates Subd.	20.0	0.12 (0.15)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	
-	04020 (017)	General Electric	-	0.12 (0.15)	- -	- -	- -	- -		BPT* BAT**	
-	04021 (017)	Central Rock	-	0.08 (0.1)	- -	15.0 (15.0)	- -	- -		BPT* BAT**	

* Best Practicable Control Technology Currently Available.
** Best Available Technology Economically Achievable.

Exhibit 5.3t

Basinwide Needs for 1980 and (1995)

Discharge Priority	Code Number (Segment Number)	Facility	Non Conservative Waste Load Allocation lbs./day TOD	Compliance Goals 1980 - (1995) Flow mgd	BOD mg/l	SS mg/l	NH3-N mg/l	DO mg/l	Other mg/l	Treatment Needs 1980- (1995)	Cost Million $ 1980
-	04019 (017)	Keeneland Race Course	13.3	0.08 (0.08)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	
-	04013 (018)	Vulcan Materials	-	0.3 (0.35)	- -	15.0 (15.0)	- -	- -		BPT* BAT**	
-	04012 (018)	I. B. M.	-	0.22 (0.30)	- -	- -	- -	- -		BPT* BAT**	
-	04011 (018)	Highland Subd.	57.2	0.07 (0.01)	20.0 (20.0)	20.0 (20.0)	15.0 (15.0)	8.0 (8.0)		T2B (T2B)	
458 Ca	04038 (020)	Nicholasville STP	125.1	0.75 (1.0)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.7 C - 2.2 I - 0.7 I/I- 0.2
-	04039 (020)	Wilmore	16.7	0.3 (0.5)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.7 C - 2.2 I - 0.7 I/I- 0.2
-	04042 (022)	Boonesboro Quarry	-	0.25 (0.28)	- -	30.0 (30.0)	- -	- -		T1A (T1A)	
-	04050 (023)	East Kentucky Recc. (C/W)	-	75.0 (75.0)	- -	- -	- -	- -		BPT* BAT**	
-	04066 (023)	Bluegrass Army Depot	62.6	0.375 (0.4)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	
235 Aa	04041 (025)	Lexington STP #1 Hickman Creek	1484.5	8.9 (12.2)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0 C -25.0 I - 8.0 I/I- 0.8
-	04040 (025)	Bluegrass Disposal Corp.	166.8	1.0 (1.5)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	
-	04048 (026)	Blue Sky Development Co.	20.9	0.125 (0.14)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	
-	04047 (026)	JFG Enterprises	11.7	0.07 (0.1)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	
672 Ba	04046 (027)	Richmond STP #2 Tate Creek	166.8	1.0 (1.22)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.4 C - 1.5 I - 0.4 I/I- 0.12

* Best Practicable Control Technology Currently Available.
** Best Available Technology Economically Available.

Exhibit 5.3t

Basinwide Needs for 1980 and (1995)

Discharge Priority	Code Number (Segment Number)	Facility	Non Conservative Waste Load Allocation lbs./day TOD	Compliance Goals 1980 - (1995) Flow mgd	BOD mg/l	SS mg/l	NH3-N mg/l	DO mg/l	Other mg/l	Treatment Needs 1980-(1995)	Cost Million $ 1980
1160 Ba	04049 (028)	Richmond STP #1 Otter Creek	220.2	1.32 (1.62)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 2.8 C - 3.5 I - 0.8 I/I- 0.18
-	04031 (030)	Kentucky State Hospital East	166.8	1.0 (1.2)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	4.0 (4.0)		T4A (T4A)	
2109 Ba	04032 (031)	Danville STP	367.0	2.2 (2.7)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.6 C - 3.2 I - 0.8 I/I- 0.3
-	04035 (031)	Caldwell Stone	-	0.65 (0.72)	- -	15.0 (15.0)	- -	- -		BPT* BAT**	
-	04033 (031)	Corning Glass (C/W)	-	0.6 (0.8)	- -	- -	- -	- -		BPT* BAT**	
-	04034 (031)	Whirlpool Corp. (C/W)	-	0.22 (0.26)	- -	- -	- -	- -		PPT* BAT**	
392 Ca	04036 (032)	Lancaster STP	50.0	0.3 (0.37)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.8 C - 0.8 I - 0.2 I/I- 0.12
200 Ca	04037 (033)	Stanford STP	53.4	0.32 (0.37)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.25 C - 0.6 I - 0.25 I/I- 0.15
121 Ca	04067 (020)	Brodhead STP	25.0	0.1 (0.15)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.4 C - 0.4 I - 0.1 I/I- 0.03
662 Ca	04043 (034)	Berea STP #2 Paint Lick Creek	83.4	0.5 (0.67)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.3 C - 1.2 I - 0.3 I/I- 0.08
398 Ca	04045 (035)	Berea STP #1 Silver Creek	166.8	1.0 (1.24)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 2.0 C - 2.4 I - 0.6 I/I- 0.17
-	04044 (035)	Brooklyn Subd.	8.4	0.05 (0.06)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	

* Best Practicable Control Technology Currently Available.
** Best Available Technology Economically Achievable.

Exhibit 5.3t

Basinwide Needs for 1980 and (1995)

Discharge Priority	Code Number (Segment Number)	Facility	Non Conservative Waste Load Allocation lbs./day TOD	Compliance Goals 1980 - (1995)						Treatment Needs 1980-(1995)	Cost Million $ 1980
				Flow mgd	BOD mg/1	SS mg/1	NH3-N mg/1	DO mg/1	Other mg/1		
20 Ca	04055 (036)	Irvine STP	450.4	0.4 (0.52)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	T - 0.6 C - 4.8 I - 1.2 I/I- 0.15
10 Ca	04056 (039)	Beattyville STP	157.6	0.14 (0.15)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	T - 0 C - 0.3 I - 0.1 I/I- 0.04
8 Ca	04051 (040)	Clay City STP	225.2	0.20 (0.25)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	T - 0 C - 0.3 I - 0.1 I/I- 0.05
-	04053 (040)	Tennessee Gas Transmission Co.	-	0.5 (0.8)	- -	- -	- -	- -		BPT* BAT**	
4 Ca	04052 (041)	Stanton STP	225.2	0.2 (0.3)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	T - 0.6 C - 2.0 I - 0.5 I/I- 0.1
87 Ca	04054 (042)	Campton STP	18.3	0.11 (0.14)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	4.0 (4.0)		T4B (T4B)	T - 0.1 C - 0.18 I - 0.05 I/I- 0.02
19 Ca	04064 (044)	Booneville STP	81.1	0.072 (0.076)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	T - 0 C - 0.24 I - 0.06 I/I- 0.02
159 Ca	04057 (047)	Jackson STP	48.4	0.29 (0.30)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	T - 0 C - 0.1 I - 0.03 I/I- 0.07
510 Ca	04059 (048)	Hazard STP	209.0	1.25 (1.3)	20.0 (20.0)	20.0 (20.0)	15.0 (15.0)	4.0 (4.0)		T2A (T2A)	T - 0 C - 0 I - 0 I/I- 0.25
288 Ca	04058 (050)	Hindman STP	20.9	0.125 (0.15)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.5 C - 0.3 I - 0.1 I/I- 0.05

* Best Practicable Control Technology Currently Available.
** Best Available Technology Economically Achievable.

Exhibit 5.3t Basinwide Needs for 1980 and (1995)

Discharge Priority	Code Number (Segment Number)	Facility	Non Conservative Waste Load Allocation lbs./day TOD	Compliance Goals 1980 - (1995) Flow mgd	BOD mg/l	SS mg/l	NH3-N mg/l	DO mg/l	Other mg/l	Treatment Needs 1980- (1995)	Cost Million $ 1980
668 Ca	04065 (051)	Manchester STP	47.5	0.285 (0.3)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.35 C - 0.2 I - 0.05 I/I- 0.1
60 Ca	04062 (054)	Hyden STP	13.3	0.08 (0.14)	10.0 (10.0)	15.0 (15.0)	1.0 (1.0)	8.0 (8.0)		T4B (T4B)	T - 0.3 C - 0.6 I - 0.15 I/I- 0.02
0 Ca	04060 (056)	Vicco STP	20.0	0.12 (0.13)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	I - 0 C - 0 I - 0 I/I- 0
81 Ca	04061 (059)	Whitesburg STP	65.1	0.39 (0.41)	30.0 (30.0)	30.0 (30.0)	20.0 (20.0)	4.0 (4.0)		T1A (T1A)	

* Best Practicable Control Technology Currently Available.
** Best Available Technology Economically Achievable.

Removal of one required nutrient, or the severe limitation of the nutrient will produce a deficiency that will inhibit cell growth. Carbon concentrations, normally present even in uncontaminated waters is of sufficient quality to meet the requirements for all growth. Nitrogen, on the other hand, may be fixed directly from the atmosphere by certain plants thus providing this nutrient requirement. Phosphorous is not normally present in natural waters in sufficient concentrations to meet the requirements for rapid growth of plant cells. It is , therefore, apparent that control of phosphorous is the most logical method of preventing eutrophication of lakes. From an economic point of view, phosphorous is the least expensive nutrient to control in the form of removal in wastewater treatment.

Based on available data, eutrophication of lakes in the Kentucky River Basin does not appear to be a problem, however, it should be quickly pointed out that data is meager. It is recommended that more extensive data be collected and evaluated by the Division of Water Quality.

Evaluation of future data may indicate the need for the development of a Lake Nutrient Model.

It is recommended that water quality monitoring in and immediately upstream of impoundments include phosphorous as a data requirement until the scope of the problem has been ascertained. Should phosphorous monitoring indicate potential eutrophication problems, then dischargers contributing this element should provide control facilties.

WATER QUALITY MONITORING AND SURVEILLANCE

The strategy for monitoring waters of the Commonwealth is being developed as a coordinated effort of State and Federal agencies who have a responsibility and direct interest in water quality in the Commonwealth of Kentucky. Agency representatives include: (Federal) U. S. Geological Survey, U. S. Army Corps of Engineers, U. S. Environmental Protection Agency, and the U. S. Department of Agriculture, Soil Conservation Service and (State) Department for Natural Resources and Environmental Protection (DRN&EP) Division of Water (Quality); DRN&EP, Division of Sanitary Engineering; Department of Fish and Wildlife; DRN&ER, Division of Conservation; Kentucky Geological Survey and Office for Local Government. These agencies working in concert are in the final stages of providing a unified strategy to meet the needs of all agencies involved in water quality management.

The current monitoring strategy was developed to its current state along two lines of need. The first need for monitoring was to locate primary water quality monitoring stations in each major river basin such that they will describe the water quality profile of the waters of the Commonwealth on a continuous basis. In addition, a secondary monitoring network has been established to supplement the data received from the primary network. A secondary station will only monitor those parameters specifically needed by individual agencies to fill in critical gaps in the information from the primary network.

Currently, the strategy is to measure the following parameters at the prescribed frequency noted in EXHIBIT 5.4t.

Exhibit 5.4t Current Monitoring Strategy

Automatic Monitor at Selected Stations	Frequency*
Temperature	H
Dissolved Oxygen	H
Conductivity	H
pH	H
General Chemical	**Frequency***
Acidity	W
Alkalinity	W
BOD-5	M
COD	M
Chloride	W
Cyanide	W
Fluoride	W
Total Hardness	W
Magnesium	W
MBAS	W
NH3-N	W
NO3-N	W
TKN	W
pH	W
Phenolics	W
Phosphorous, Total Dissolved	W
Total Phosphorous - P	W
Potassium	W
Solids Dissolved	W
General Chemical	**Frequency***
Solids Suspended	W
Sulfate	W
Sulfide	W
Sodium	W
Turbidity	W
Silica	W
TOC	W
Trace Elements	**Frequency***
Arsenic	W
Barium	M
Cadmium	M
Chromium, Total	M
Chromium, Hexavalent	as needed
Copper	M
Iron	M
Lead	M
Manganese	M
Mercury	M
Nickel	M
Selenium	Q
Silver	M
Zinc	M
Radio Chemical	**as needed**
Pesticides	**as needed**
Bacterial	**Frequency***
Coliform, Fecal	W
Coliform, Total	W
Biological	**as needed**
Sedimentation	**Frequency***
Particle size distribution	**as needed**

* C = Continuous; H = Hourly; D = Daily; W = Weekly; M = Monthly; Q = Quarterly

Primary Station Network

A summary of the proposed primary monitoring stations located in the Kentucky River Basin is presented in EXHIBIT 5.5t; their location in the basin is shown on EXHIBIT 3.8m.

EXHIBIT 5.5t Primary Monitoring Stations*

1. Primary Stations with Flow and Quality Records

Station Number	Location	Flow Type	Quality Type	FY '76 Monitoring
043	Ky. River, L&D #2	F7	Q1	A
045	Ky, River, Frankfort	F2	Q21,Q24,	H,I,J,K
048	Ky. River below Point Lick Creek	F7	Q15	G,I
049	Ky. River, Lexington, WPI	F7	Q14	H,I
050	Ky. River, L&D #14	F1	Q20	H,I,K
051	Eagle Creek Glencoe	F2	Q1	D
055	Red River at Hazel Green, Ky.	F2	Q30	B,E,
056	M.Fork Ky, River Hyden	F1	Q20	E

2. Primary Stations with Flow Records Only

Station Number	Location	Flow Type	FY '76 Monitoring
C44	Ky, River, below Frankfort	F2	G
046	Ky. River, below Jessamine Creek	F7	G

3. Primary Lake Headwater Stations

Station Number	Location	Stream Mile Index	FY '76 Monitoring
053	Dix River near Danville	435.6-118.2 34.65	D,G

4. Primary Stations with No Flow or Quality Records

Station Number	Location	Stream Mile Index
047	Hickman Creek, below East and West Forks	435.6-136.5-21.3
052	S. Elkhorn, Ky - 341 Bridge	435.6-52.1-17.8-19.7
054	Clarks Run, Danville	435.6-118.2-26.2-7.0

* Explanation of symbols used in this exhibit is presented in EXHIBIT 5.5At.

EXHIBIT 5.5At Explanation of Symbols used in EXHIBIT 5.5t

Flow Type Symbol	Frequency	Recorded	Telemetered	Discharge Frequency+
1	1	Yes	Yes	Monthly
2	1	Yes	No	Monthly
3	1	Yes	No	Seasonal
4	1	Yes	Yes	Monthly
5	1	No	No	Monthly
6	1	Yes	No	-
7	3	No	No	Monthly
8	5	No	No	Monthly
9	5	No	No	Seasonal
10	-	No	No	-

Parameter	Quality Record Type Symbols					
	Q1	Q14	Q15	Q20	Q21	Q24
Temperature	C	W	W	A	-	C
Specific Cond.	C	-	-	A	-	C
Turbidity	-	A	-	-	P	-
Color	M	-	-	-	P	-
Odor	-	-	-	-	P	-
pH Field	-	-	-	-	P	C
pH Lab	M	A	-	A	P	-
Diss. Solids	M	A	-	A	P	-
Chlorine	M	A	-	A	P	-
Phosphorous	-	A	-	A	P	-
Common Ions	M	A	-	A	P	-
Hardness	M	A	-	A	-	-
Diss. Oxygen	A	-	-	-	-	C
Coliform	-	-	-	-	-	-

Symbol	Monitor Level For FY'76
A	NSQAN:USGS
B	Minor Element; USGS
C	Temperature and Common Constituents; USGS
D	Common Constituents (C. of E.); USGS
E	Temperature and Specific Conductance; USGS
F	Temperature Only; USGS
G	pH, Temp., Specific Cond., D.O.;Ky. (Monthly)
H	Minor Elements, Ky. (Monthly)
I	Bacteriological
J	Radio Chemical, Ky. (Monthly)
K	pH, Temp., Specific Cond., D.O.; Ky. (Continuously)

Secondary Monitoring Network

The current monitoring strategy also includes an additional 101 secondary monitoring stations located at various points throughout the state to supplement and complement the primary monitoring network. Twenty-two of these secondary stations are located in the Kentucky River Basin to observe specific parameters on a needs basis. (See EXHIBIT 3.8m) Although the monitoring team has not set the parameters to be observed at all secondary stations, the suggested critical parameters for each is listed in EXHIBIT 5.6t along with each station's proposed location. Also included in EXHIBIT 5.6t is a list correlating each secondary station with the particular agencies with a specific interest in the data collected at that station.

In conjunction with the water quality monitoring and surveillance strategy, it is prooposed that an extensive sampling program be implemented once during each five year planning period. This program would help calibrate the Water Quality Model and provide necessary data essential to upgrading of all water quality planning.

Remaining Strategy to be Accomplished by Water Quality Monitoring Team

The team should determine the exact level of activity and responsibility of each participating organization in regard to monitoring the water quality of lakes in the state and result of the 303e River Basin continuing planning effort and the 305b annual Water quality Inventory Report to Congress. The team should also make any final adjustment in the primary network as deemed necessary. A parameter and frequency schedule for secondary stations should also be developed along with a continuing update procedure for primary and secondary network. Finally, mechanisms should be developed for funding of the monitoring program and for implementing the network.

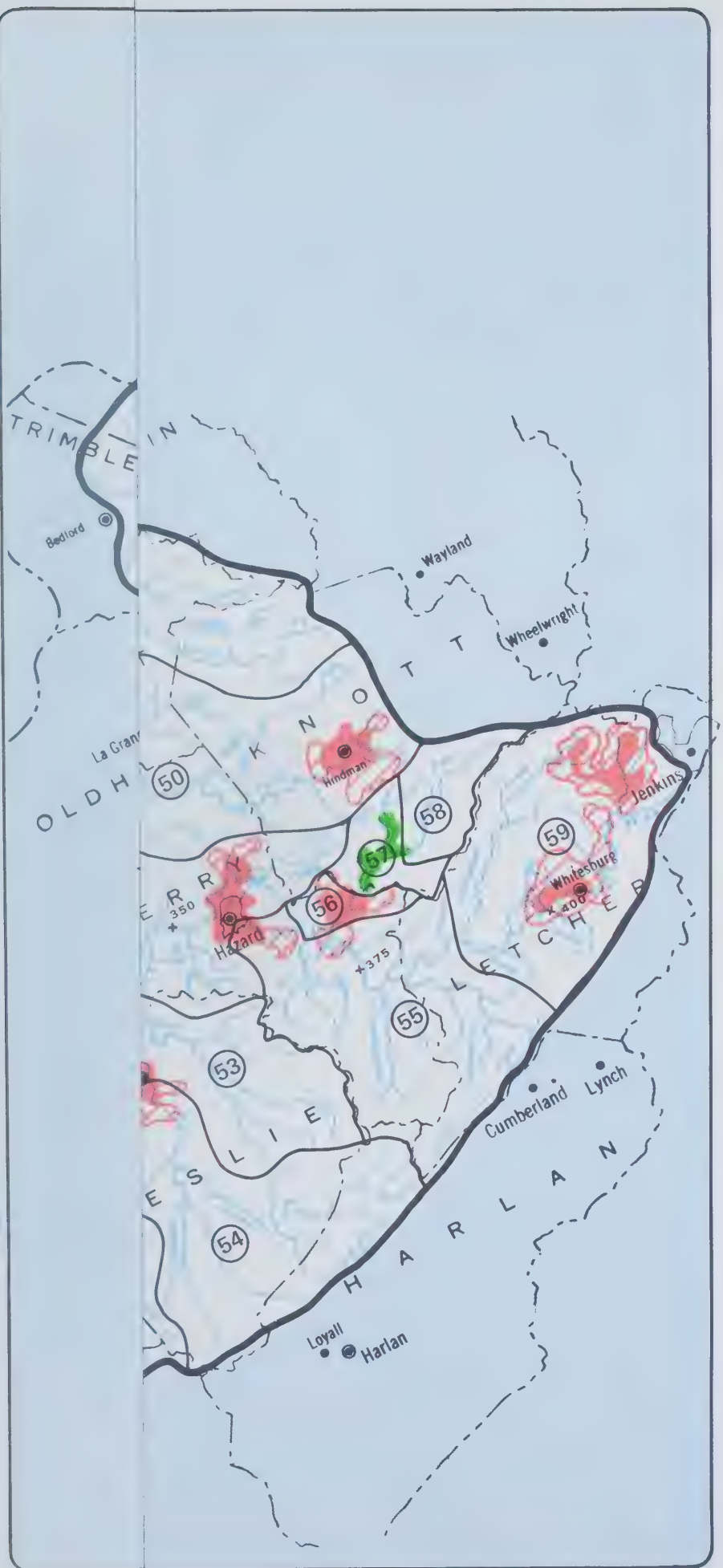
Exhibit 5.6t

Secondary Monitoring Network

Temporary Code No.	Station Location	River Mile Location	Other Activity **	Existing Parameters	Existing USGS Station at Location
#155	Kentucky River, L&D #6	96.2	SE	DO, NH3-N	No
#156	Kentucky River, L&D #8	139.9	GS, SE	DO	No
#157	Silver Creek, Richmond	TBD*	GS	DO, NH3-N	#03284500
#158	Otter Cr., Ky., 388 Bridge	177.3-5.8	EPA	DO, NH3-N	No
#159	Kentucky River, L&D #11	201.0	SE, DW	DO, NH3-N	No
#160	Dix River, Burgin	118.2-3.0	GS, DW	P, DO, Fe, Mn	#03286200
#161	Dix River, Danville WPI	118.2-18.7	EPA, SE, DW	P, DO, Fe, Mn	No
#162	Dix River, Stanford	118.2-51.0	GS	P, DO, NH3-N	#03284800
#163	Red River, Ky. 613 Bridge	190.8-40.4	CE, EPA	SC, pH	No
#164	Red River, Pine Ridge	190.8-41.1	GS	SC, pH	#03283100
#165	S.Fork Ky.River, Booneville	254.8-11.4	GS, CE	pH, SS, SC	#03281500
#166	Redbird River, Big Creek	254.8-11.4	GS, CE	pH, SS, SC	#03281030
#167	M.Fork Ky. River, Tallega	258.6-8.3	GS, SE, DW, EPA	pH, SS	#03281000
#168	M.Fork Ky. River, Buckhorn	258.6-42.9	CE	pH, DO, P	#03280800
#169	M.Fork Ky.River,Buckhorn Lk.	TBD*	CE, EPA	P, DO, Fe, Mn	No
#170	N.Fork Ky. River, Jackson	304.5	GS	pH, SS	#03280000
#171	Quicksand Creek, Quicksand	307.8-0.7	GS	pH, SS	#0327970
#172	N.Fork Ky. River, Hazard	361.0	GS, SE, DW	pH, SS	#03277500
#173	Carr Fork, Sassfrass	367.8-8.6	GS, CE	P, pH, SC	#03277450
#174	Carr Fk., Little Carr Fk.	367.8-16.4	CE	pH, SS	No
#175	Leatherwood Cr., Daisy	378.7-1.2	GS	pH, SS	#03277400
#176	N.Fork Ky. River, Blackey	387.9	GS	pH, SS, DO, NH3-N, SC	No

* Exact location to be determined.

** CE = Corps of Engineers, EPA = Environmental Protection Agency, GS = Geological Survey, SE = Division of Sanitary Engineering (State of Kentucky), DW = Division of Water (State of Kentucky)



KENTUCKY RIVER BASIN

EXHIBIT 5.7m

RELATIONSHIP TO OTHER PLANS

LEGEND

- 5 — LOCK AND DAM NUMBER
- +50 — RIVER MILE
- INTENSIVE 201 PLANNING AREA
- GENERAL 201 PLANNING AREA
- SOIL CONSERVATION SERVICE STUDY AREAS
- CORPS OF ENGINEERS LAKE STUDY AREAS
- CORPS OF ENGINEERS URBAN STUDY AREA

5 0 10 20

GRAPHIC SCALE IN MILES

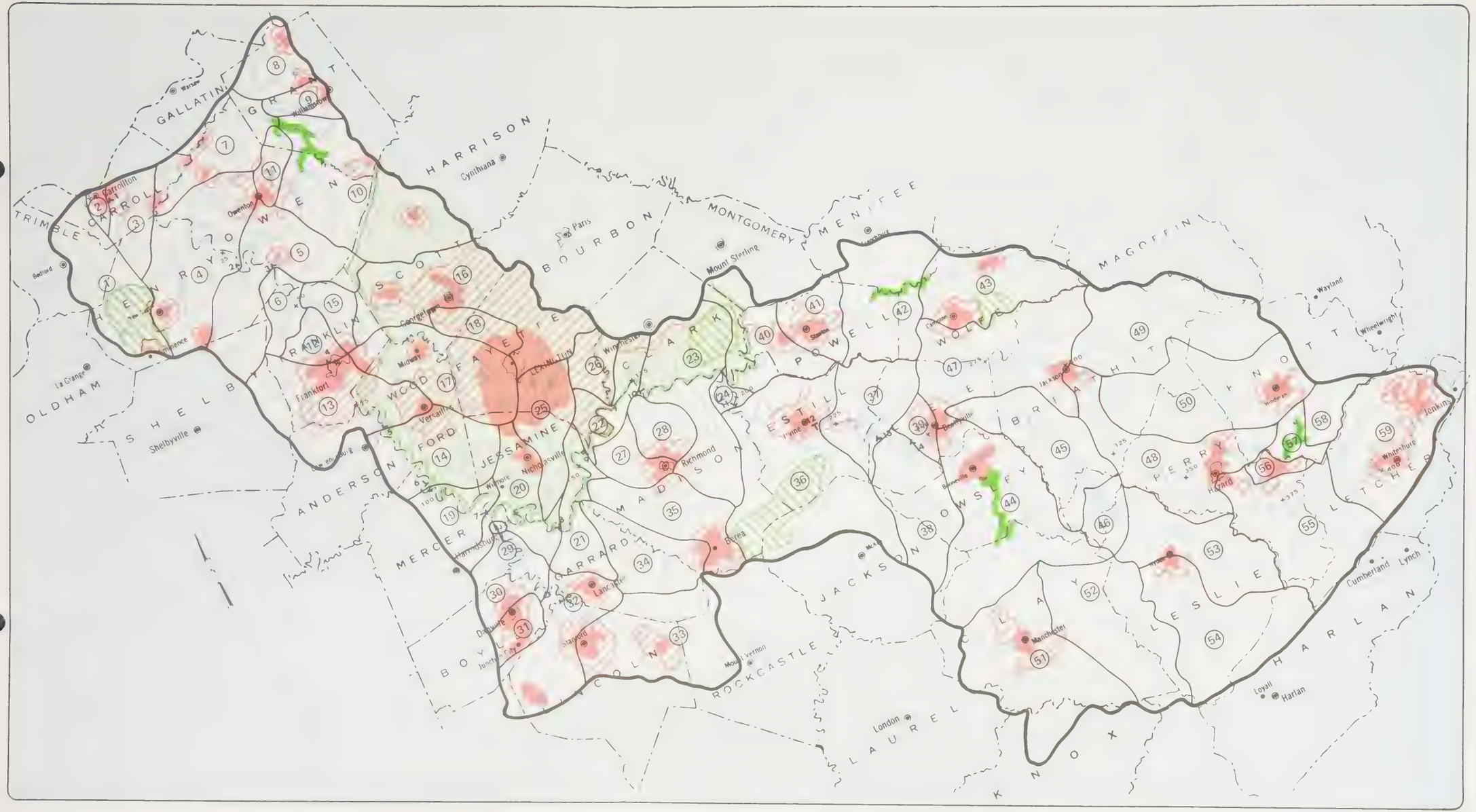
Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

Prepared for Division of Water Quality

KENTUCKY DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION

Miller, Wihry & Lee
INCORPORATED
Landscape Architects and Engineers
Landward House • 1387 South Fourth Street • Louisville, Kentucky



KENTUCKY RIVER BASIN

EXHIBIT 5.7m

RELATIONSHIP TO OTHER PLANS

LEGEND

- 5 LOCK AND DAM NUMBER
- 50 RIVER MILE
- INTENSIVE 201 PLANNING AREA
- GENERAL 201 PLANNING AREA
- SOIL CONSERVATION SERVICE STUDY AREAS
- CORPS OF ENGINEERS LAKE STUDY AREAS
- CORPS OF ENGINEERS URBAN STUDY AREA

5 0 10 20

GRAPHIC SCALE IN MILES

Base Data: U. S. Geological Survey

KENTUCKY WATER QUALITY MANAGEMENT PLAN

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RELATIONSHIP WITH OTHER PLANS

As part of the Department for Natural Resources and Environmental Protection's effort to develop a comprehensive management plan for improving water quality in the Kentucky River Basin and in each of the other basins located throughout the Commonwealth, it is useful to have available an inventory of all water quality and resources plans which impact on water quality. By analyzing and understanding the relationship among these various planning and development efforts, a comprehensive and effective water quality management process can be developed and implemented.

Federal Water Pollution Control Act

Several distinct planning processes were established in the Federal Water Pollution Control Act Amendments of 1972. Each of these processes has a specific scope and purpose and is dependent upon the other for its ultimate effectiveness.

River Basin Plans - Section 303(e)

The basic purpose of river basin plans is to coordinate and direct activities related to water quality management on a river basin scale. It is the intent of basin plans to provide for orderly water quality management by:

(1) Identifying Problems - determining existing water quality, applicable water quality standards, and point and non-point sources of pollution.

(2) Determining Priorities - assessing water quality and abatement needs so as to establish priorities for awarding construction grants, processing permits, and taking other needed steps to achieve water quality goals.

(3) Scheduling Actions - setting forth compliance schedules or target abatement dates and indicating necessary state and local activities.

(4) Coordinating Planning - identifying needs and priorities for 201 Facility Plans and 208 Areawide Plans within the basin and reflecting the results of those activities.

This, the Kentucky River Basin Plan, is one of nine which has been prepared for each of the river basins in Kentucky. Together, the river basin plans will provide the Department for Natural Resources and Environmental Protection a comprehensive basis for implementing a continuing water quality management program for the Commonwealth.

Waste Treatment Facilities Planning - Section 201

The basic purpose of waste treatment facilities planning is to produce cost effective, environmentally sound and implementable waste treatment works. An important element in the 201 planning process is the development, critical analysis and costing of alternative waste treatment methods which may include land treatment or reuse of wastewater, flow reduction measures (including the correction of excessive infiltration or inflow) the treatment of overflow, alternative system configurations, phased development of facilities, or improvements in operation and maintenance.

Through the water quality assessment process developed in the river basin planning effort, effluent limits are established for point source dischargers and funding priorities developed for expanding and upgrading waste treatment facilities.

The following communities within the Kentucky River Basin are currently engaged in or are scheduled for 201 Studies:

Beattyville
Berea
Booneville
Brodhead
Campbellsburg
Campton
Carrollton
Clay City
Corinth
Crab Orchard
Crittenden
Danville
Dry Ridge
Eminence
Frankfort
Georgetown
Hazard
Hazel Green
Hindman
Hustonville (including Moreland and Milledgeville)
Hyden
Irvine-Ravenna
Jackson
Lancaster
Lawrenceburg
Letcher County Service Area (Whitesburg, Neon-Fleming, McRoberts)
Lexington
Manchester
Midway
Monterey
New Castle
New Liberty
Nicholasville
Owenton
Pleasureville
Richmond
Sadieville
Sparta-Sanders
Stamping Ground
Stanford
Stanton
Versailles
Vicco
Williamstown
Winchester

The above list of 201 Study Areas are shown on EXHIBIT 5.7m.

Areawide Waste Treatment Management Plans - Section 208

The purpose of Areawide Waste Treatment Management Plan is to develop comprehensive areawide waste treatment management strategies in areas which have substantial water quality control problems resulting from urban-industrial concentrations or other factors. Through the 208 planning process, local communities can develop and manage a comprehensive program to control municipal and industrial wastewater, storm and combined sewer runoff, non-point source pollutants and land use as it relates to water quality.

Within the Kentucky River Basin, the area around Lexington has been proposed for 208 planning. This proposed study area will include all of Fayette, Jessamine and Woodford Counties, that portion of Scott County not drained by Eagle Creek and a small portion of Clark County drained by Boone Creek.

At the present time the U.S. Army Corps of Engineers is conducting a Metropolitan Lexington Area

Study as part of its Urban Studies Program. The area of the Corps study includes the Lexington Standard Metropolitan Statistical Area as defined by the U.S. Bureau of Census. This includes Fayette, Woodford, Scott, Bourbon, Clark and Jessamine Counties. Of these counties, all but Bourbon and portions of Clark counties are within the Kentucky River Basin.

The purpose of the study is to formulate integrated solutions to all phases of water resource problems and follows very closely the work carried out under a 208 study. Specifically, the study will develop alternative solutions for five areas of concern including: wastewater management, water supply, flood control, flood plain management, and water based recreation. The planning period will extend fifty years into the future to the year 2025. Detailed plans including costs and phasing will be provided for the immediate twenty year period with a more general outline for the subsequent thirty year time frame.

Work on the Lexington Study was originated in February 1974. Major work tasks completed to date include publication of an Environmental Resources Inventory for the Lexington, Kentucky Urban Area and a survey report on the quality of surface waters in the six county area. The final completion date of the study is dependent upon Congressional funding, but is expected to require three years of effort.

Corps of Engineers

Flood control projects carried on by the Corps of Engineers generally fall into three categories: (1) protection by means of storage of flood flows (in lakes); (2) protection by means of localized barricades against overbank flood flows (wall and levee systems); and (3) protection through provision of increased capacities to carry flood flows (channel improvements). According to the Corps of Engineers, low-flow augmentation for water quality improvement no longer is a primary purpose of Corps lake projects; however, the minimum release from these dams will always be in excess of the normal low-flow of the affected streams which the Corps defines as "the natural flow of the stream" and takes into account periods of virtually dry streambeds during late summer and similar dry periods. At Carr Fork Lake, for example, release is in accordance with the lake "rule curve" and ranges from 2 cfs to 100 cfs depending upon the impoundment elevation and storage and the quality of downstream water. Corps projects within the Kentucky River Basin include:

Lakes

Carr Fork Lake - The Carr Fork Lake will be located in the mountainous region of southeastern Kentucky, approximately 16 miles from Hazard and 25 miles from Whitesburg. The dam is located in Knott County, 8.8 miles above the mouth of Carr Fork and controls the runoff from 58 square miles of drainage area. A minimum pool at elevation 1009 will be maintained and have a capacity of 11,810 acre-feet and an area of about 530 acres. The maximum pool at elevation 1055 will provide 31,560 acre-feet of flood control storage and have an area of 1,120 acres. Allocation of storage capacity for water quality control is 4,330 acre-feet. The summer recreation pool will be at elevation 1027 and have an area of 710 acres.

The lake will be operated mainly to reduce flood heights on Carr Fork and North Fork of the Kentucky River. Construction was started on the project in January 1966 and is expected to be completed in 1975.

Booneville Lake - The proposed Booneville Lake damsite is located on the South Fork of the Kentucky River, 19.4 miles above the mouth and about 3 miles south of Booneville in Owsley County. The lake will extend into Clay County and control the runoff from a drainage area of 665 square miles. A seasonal pool at elevation 736 for recreational use will have a surface area of approximately 3,000 acres. Advanced engineering and design work for this project has been completed, but construction has not yet begun.

Eagle Creek Lake - The proposed Eagle Creek Lake would be located approximately 30 miles south of Cincinnati, Ohio, and 60 miles northeast of Louisville, Kentucky. The dam would be located in Grant County, about 38.5 miles above the mouth of Eagle Creek and would control the runoff from 292 square miles of drainage area. A minimum pool at elevation 670 would be maintained and have a storage capacity of 65,000 acre-feet and an area of about 2,750 acres. The maximum pool at elevation 710 would provide 197,000 acre-feet of flood control storage and have an area of 8,180 acres. A seasonal pool will be provided from April to September each year and will have an area of 3,600 acres at elevation 680. Construction has not begun on this project as it is currently on the Corps' "Inactive" list.

Red River Lake - The proposed Red River Lake project was authorized by the Flood Control Act of 1962 for the purpose of flood control, water supply and water quality control, general recreation, and fish and wildlife enhancement. The lake would be located on the Red River in Daniel Boone National Forest in Powell, Menifee and Wolfe Counties.

In response to the numerous requests for re-evaluation of the project, a restudy of the possible developments in the Red River Valley was undertaken in 1968. The restudy concentrated on evaluation of an alternate damsite located 5.5 miles downstream from the approved site. This site would save the natural area in the upper gorge from the most adverse effects. In the restudy, the comments and recommendations of conservationists groups and individuals on the natural, scientific and aesthetic values to be preserved in the gorge were carefully evaluated. A compromise agreement was reached with the Commonwealth setting the lake's seasonal pool at elevation 703 feet msl and the flood control pool at elevation 759 feet msl. The dam at the alternate downstream site would control 235 square miles of drainage area. The flood control pool would cover 3,177 acres and have a capacity of about 168,000 acre-feet.

The lake would be operated as a unit of the coordinated lake system for the reduction of flood heights in the Kentucky and Ohio River valleys. The Red River Lake project is currently in litigation.

Snagging and Clearing Projects

Section 3 of the River and Harbor Act of 1945 and Section 208 of the Flood Control Act of 1954 provide authority for the Chief of Engineers to snag and clear streams in the interest of navigation and flood control.

Of interest here is a project that consisted of clearing, snagging and channel improvements along 4.8 miles of the North Fork of Kentucky River near Millstone. A report in 1968 recommended selective clearing, snagging, cleaning, and a small amount of channel improvement. Completion of a restudy and revision of the report is presently unscheduled.

Kentucky River Navigation Project

The Kentucky River Basin Navigation project, a part of the larger Ohio River navigation system, joins the Ohio at Carrollton. It comprises a system of 14 locks and dams affording slackwater navigation on the Kentucky River from its mouth to Beattyville, 259 miles upstream. The first five locks and dams were constructed by the Commonwealth of Kentucky and subsequently ceded to the United States in 1880. Locks and Dams 6 to 14 were constructed by the Federal government and the acquired locks and dams were rehabilitated in 1917, providing a minimum navigable depth of six (6) feet throughout the project. Navigation-maintenance dredging throughout the project is planned. The Kentucky Utilities Company has constructed and operates a hydro-electric plant at Dam No. 7, under Federal Power Commission license.

During 1973 over 99 percent of the total traffic on the Kentucky River was inbound shipments of sand, gravel and crushed rock. Average annual traffic for the period 1969-1973 was about 565,000 tons.

Small Flood Control Projects

Section 205 of the Flood Control Act of 1948, as amended, provides authority for the Chief of Engineers to develop and construct small flood control projects, within cost limitations prescribed by the law, provided each project is complete within itself and economically justified. Projects being conducted under this authority include:

Danville - Headwater flooding from Clarks Run occurs two to three times yearly damaging the Federal housing project and the City sewage treatment plant. Danville is about 80 miles southeast of Louisville in Boyle County. A study of the problem is in progress under authority of Section 205 of the Flood Control Act of 1948.

Nicholasville - Nicholasville is located approximately ten miles south of Lexington in Jessamine County. The flooding problem occurs along Town Fork which flows through downtown Nicholasville. Headwaters flooding from Town Fork occurs about once annually and causes damage to the business district and the city sewage treatment plant. A detailed project report is scheduled for completion in 1975.

Frankfort - The Frankfort Local Protection Project is located at the City of Frankfort on the Kentucky River in Franklin County. It will protect 2,224 acres of urban and suburban land in the North Frankfort and Jones Run areas against a flood equal to that of February 1937, the maximum of record. The protection will be enhanced by construction of lakes on the Kentucky River above Frankfort. One lake (Burkhorn) is in operation and another (Carr Fork), now nearing completion, is effective for flood control. The project includes approximately 3,300 feet of earth levee with an average height of 28 feet, 700 feet of concrete wall, two pumping plants and 4 closures in the Jones Run and Old Capitol areas. Construction started in March 1968 and was completed in September 1970. The Benson Creek, 2,300 feet of wall, 800 feet of levee and two pumping plants are proposed for the Benson Creek Area, while the New Capitol area in South Frankfort will consist of 5,570 feet of concrete wall and pumping plants. However, work has not as yet begun at either of these two locations.

Soil Conservation Service

Conservation Measures

The Soil Conservation Service (SCS) of the U.S. Department of Agriculture, provides assistance to individuals, groups, and organizations in conserving and developing water and related land resources within the Commonwealth. Emphasis is given to integrating the various aspects of water conservation and management with land use and treatment needs. The interdependency of water and soil conservation is the main thrust of SCS assistance in planning and installing vegetative measures, farm ponds, floodwater retarding structures, and other applicable conservation measures.

In addition to providing technical assistance in the planning and installation of applicable conservation measures in each of the county soil and water conservation districts in Kentucky, SCS also provides leadership for the National Cooperative Soil Survey, Resource Conservation and Development projects, and the small watershed program. RC&D project objectives include an acceleration of multicounty resource programs as a basis for town-county economic development. Watershed protection and flood prevention project measures are eligible for Federal assistance.

Small Watershed Projects

The Watershed Protection and Flood Prevention Act (P.L. 566) authorizes Federal assistance to local units of government for (1) accelerating land use adjustments and treatment measures for watershed protection, and (2) works of improvement for flood prevention, agricultural water management, public recreation, and fish and wildlife. Water supplies for other purposes may be incorporated in small watershed reservoirs at local cost. Small watershed projects help to bridge the gap between conservation measures applied on individual tracts of land and major works of improvement installed on rivers and downstream areas by others.

Exhibit 5.8t

Kentucky River Basin Watershed Projects *

Projects Approved for Construction	Location	Acres (000)	Structural Measures P - Planned C - Completed or Contracted								Total Estimated Cost ($000)	
			Floodwater Detention		Multi-Purpose		Other		Channel Modif. (Miles)			
			P	C	P	C	P	C	P	C	Federal	Other
Upper Howard Creek	Clark County	17			1				1	1	391	406
Little Kentucky River	Henry & Trimble Counties	46	4	4	1	1	1				952	809
Red Lick Creek	Madison, Estill, Jackson Counties	45	4	1	1	1					739	702

* Source: Soil Conservation Service

Small watershed projects within the Kentucky River Basin are listed in EXHIBIT 5.8t and include the following:

Upper Howard Creek Watershed Project (Clark County) - This project includes one multiple purpose structure with recreational facilities. It is approved for operation but as yet, no construction is underway.

Red Lick Creek Watershed Project (Estill, Jackson, and Madison Counties) - This project is approved for operations and consists of installing four floodwater retarding structures and one multiple purpose structure. The MPS structure and one FRS structure are currently under construction.

Little Kentucky River Watershed Project (Henry and Trimble Counties) - This project involved 46,000 acres for flood retention and recreation. Completed in 1969, the cost of the project was $1.7 million.

Chamberlain Branch Flood Protection Project (Estill County) - This project consists of installing one flood retarding structure to provide protection to citizens of the communities of Irvine and Ravenna. A preliminary investigation has been made and approval for planning will soon be requested.

Cumberland Valley Resource Conservation and Development Project - The Cumberland Valley Resource Conservation and Development Project, currently in the planning stages, involves the Kentucky River Basin Counties of Clay, Rockcastle and Jackson. The project will include water resource studies together with structured measures.

Kentucky and U. S. Geological Surveys

The Kentucky Geological Survey and the U.S. Geological Survey have an on-going, cooperative program for monitoring streams and rivers throughout the Commonwealth. At the present time, 26 stream gauging stations, 12 stream temperature stations and 11 stream quality stations are maintained by the USGS in the Kentucky River Basin. Data gathered at these points are published each year in a document entitled "Water Resources Data for Kentucky", Part 1. Surface Water Records, and Part 2. Water Quality Records.

Other studies currently being conducted by the U.S. Geological Survey that pertain to the Kentucky River Basin include:

(1) Hydrology of the Lexington-Louisville-Covington Triangle

This study is being conducted for the Kentucky Department of Commerce. The objectives of the study are:

(a) To define the hydro-geologic properties that control availability of groundwater.

(b) To determine the rate and direction of ground water movement in cavernous limestone which can provide an easy path for wide-spread dispersion of pollutants.

(c) To evaluate the potential of deep aquifers and small streams as sources of water with chemical characteristics acceptable to industrial users.

This is a three year study which is expected to be completed in late 1975.

(2) Study of Ground Water in the Kentucky River Alluvium

This study involves the Ohio River and its tributaries with the purpose of obtaining information on the quantity and quality of water available in the

Kentucky River Alluvium in order to guide water development in the proper design, location and spacing of wells. The study is currently in a colleague review process and is scheduled to be available in late 1975.

(3) Downstream Effects of Local Mining on Water Quality in the North Fork of the Kentucky River

This study is being conducted to ascertain the impact that coal seams and overburden material have on water quality. This study is currently in progress and is expected to be completed and available in early 1976.

Rural Development Act of 1972

The Rural Development Act of 1972 was designed to initiate and provide manpower, loans and grants for a variety of projects including rural, industrial and business development; water and waste plans and facilities; community facility projects; watershed, flood and general environmental protection projects; fire protection; research and education programs; rural development planning; housing; and land inventory and monitoring for guidance of balanced community development. To date, the Act has been only partially authorized and funded.

The Farmers Home Administration administers part of the authorized Rural Development Program which includes loans for extending water and sewer services to existing rural residences.

The Rural Development Act also has impact upon Soil Conservation Service programs. Funding procedures for watershed projects have been altered allowing local sponsors to apply to other Federal agencies for funds to match SCS monies. Under implemented procedures of the Act, SCS can now construct measures for improving water quality.

Wild Rivers Act

The Kentucky Department for Natural Resources and Environmental Protection, Division of Special Programs has responsibility for administering Kentucky's Wild Rivers Act. Within the Kentucky River Basin, the Red River from Kentucky 746 Bridge to the mouth of Swift Camp Creek has been designated "wild". The area for control under the Wild Rivers Act extends 2,500 feet laterally from the center of the stream, along both banks. The Wild Rivers staff is directed to monitor the wild streams to insure preservation of their natural state, to continue a program of land purchases or easements, and to investigate various streams to determine if they qualify as additions to the Wild River System. A Beautification program and the Revolving Fund for Orphan Land Reclamation also come under the aegis of the Division of Special Programs.

National Flood Insurance Act

The National Flood Insurance Act of 1968 made flood insurance available for the first time. Insurers had not previously provided flood insurance because of the difficulty of determining premium rates and the other catastrophic nature of floods. The flood insurance program, which was expanded in the Flood Disaster Protection Act of 1973, is administered by the U.S. Department of Housing and Urban Development and is designed to create a cooperative effort between the Federal government and the commercial insurance industry with the former providing a subsidy. The Act requires that State and Local governments adopt and administer flood plain management regulations for the flood prone areas within their jurisdiction.

In order to qualify for the flood insurance, appropriate officials of the community or county must indicate that there is a local need for the coverage and must give evidence of their desire to participate in the program together with a commitment that they will enforce land use control measures designed to reduce exposure to flooding.

Areas within the Kentucky River Basin which are currently involved in flood plain studies preparatory to participating in the insurance program are listed in EXHIBIT 5.9t.

Exhibit 5.9t - Floodplain Studies *

River	Locality	Status
Kentucky River (Main Stem, N&S Forks)	Beattyville, Lee County	Underway
Kentucky River	Frankfort, Franklin Co.	Negotiations
N.Fork Kentucky River (Lotts Cr. & Upper 2nd Cr.)	Hazard, Perry Co.	Study Complete
S. Elkhorn Creek	Lexington, Fayette Co.	Negotiations
Dix River	Stanford, Lincoln Co.	Underway
Jessamine Creek	Wilmore, Jesseamine County	Negotiations
Numerous Watersheds	Boone Co.	Negotiations
" "	Fayette Co.	Contracting
" "	Harlan Co.	Negotiations
" "	Jessamine County	Contracting
" "	Mercer Co.	Negotiations
" "	Woodford County	Underway

* Source: U.S. Department of Housing and Urban Development, Federal Insurance Admin.

Kentucky Department for Natural Resources and Environmental Protection

Among the Department for Natural Resources and Environmental Protection's water quality related programs is the Surface Mining Water Quality Research and Demonstration Project, within which are the following four subprograms.

(1) Reuse of Acid Mine Drainage Project;

(2) Demonstration of Debris Basins in Steep Slope Terrain;

(3) Demonstration of Coal Mine Haul Road Sediment Control Techniques; and,

(4) On Site Control of Surface Mine Sedimentation Project.

In addition, the Solid Waste Division through inspections, regulations, training, technical assistance and public education on solid waste disposal also deals with a significant land use issue which impacts upon water quality.

U.S. Forest Service

The U.S. Forest Service's Northeast Forest Experiment Station at Berea, Kentucky, inaugurated its Strip-Mine Area Restoration Research Project in 1962 to investigate problems associated with strip mining throughout the Appalachian coal fields. The objectives of this project were to find ways to: (1) reduce damage to forest resources - water, wildlife, recreation, timber and range during mining and (2) restore forest resources on strip mined land as rapidly as possible, compatible with adjacent land use. The research program covered five major disciplines including revegetation, hydrology, earth movement and placement, spoil chemistry and coal-haul roads. The Berea Forest Station has issued a publication entitled "An Annotated Bibliography of the Surface-Mined Area Restoration Research Project" which lists more than 80 bulletins, research papers and technical magazine articles which have been prepared by the project's personnel through September 1974.

Area Development Districts and Local Government

In addition to the many planning activities carried out by federal and state agencies, numerous plans have been prepared by and for Area Development Districts and local units of government which impact directly and indirectly upon water quality. Examples of these plans include comprehensive community development plans, land use plans, water and sewer plans, park and recreation plans and transportation plans. The list of these plans prepared for communities and regional agencies within the Kentucky River Basin is quite lengthy and, therefore, will not be listed herein; however, a comprehensive list of these plans and specific details may be obtained from the Office for Local Government within the Executive Department for Finance and Administration.

As evidenced in the preceding pages, a variety of planning and development efforts operate within the Kentucky River Basin which impact upon water quality. A variety of forces and agencies are involved including local government, regional organizations and federal agencies. Some of the programs are sponsored and fostered by local initiative, others by federal mandate and, as result, plans are sometimes in conflict with one another. Therefore, in order to effectuate a timely comprehensive water quality management strategy, a process must be developed whereby each agency and organization whose efforts impact upon water quality are in some rational manner striving toward larger state and federal water quality objectives.

LAND USE POLICIES AND CONTROLS

The ways in which we utilize or conserve our land resources have significant impacts on water quality. Community growth in some areas follows carefully planned programmed and staged infrastructure development while in many more areas, growth takes place in an uncoordinated manner with development taking place completely irrespective of the community's ability to provide basic public services such as water and sewers.

The Present Situation

Land use planning which has been undertaken in the past in the United States has been carried out chiefly by local governments. Authorization for local units of government to prepare and administer land use plans has been in the form of state enabling legislation. Beginning in the 1920's with the federal government's publication and promotion of model enabling and zoning legislation, states were encouraged to delegate land use planning responsibilities to local governments.

Kentucky's planning statutes contained in KRS Chapter 100 including the 1966 revisions are based essentially on 50 year old enabling law - enabling laws which were designed for communities of a different era. Cities were compact, undeveloped land was abundant and the environmental and social consequences of development were not of major concern. Land was viewed as a commodity, and zoning and other regulatory measures were tools utilized chiefly for the purpose of protecting property values.

However, times and conditions have changed, yet we are still utilizing in many communities statutes and ordinances designed for an earlier period. The basic problem with zoning and other planning tools such as the comprehensive plan is that they are essentially negative, relying on the police power to protect the public safety, health and welfare. This is the opposite of incentive zoning which encourages desirable development to take place in proper locations.

Another major deficiency in past land use planning efforts in the United States has been that local units of government were given land use planning authority but were frequently not given adequate financial and technical assistance to effectively utilize the authority.

Planning tools which are currently available to cities and counties in Kentucky under KRS Chapter 100 include: (1) comprehensive plans containing a statement of goals and objectives and principles, policies and standards to serve as a guide for the physical development and economic and social well-being of the planning unit, together with plans for land use, transportation and community facilities. A comprehensive plan may include any additional elements such as community renewal, housing, flood control, pollution, conservation, natural resources, and other programs which in the judgement of the planning commission will further serve the purposes of the comprehensive plan; (2) zoning regulations; (3) subdivision regulations; (4) an official map; and (5) a capital improvement program and budget.

Land use planning was first introduced to many of Kentucky's smaller communities with the enactment of the Housing Act of 1954. Section 701 of the Act was originally designed to facilitate urban planning for smaller communities which lacked adequate planning resources. Planning activities funded through the 701 program during its first 10 to 15 years of existence were almost exclusively concerned with physical planning including inventories of land use and other existing conditions, population and economic base analysis, plans for land use, community facilities, circulation and recreation, preparation of zoning ordinances, subdivision regulations and capital improvement programs. A large number of 701 funded comprehensive plans and zoning ordinances were prepared for Kentucky communities during the period from 1954 to 1970, many of which are in force today, essentially in their original form. Unfortunately, many of these comprehensive plans have major deficiencies in terms of present day environmental demands. For example, most of Kentucky's community comprehensive plans did not inventory the capability or the suitability of the natural environment to accommodate various levels and kinds of development and only a small number are backed up by important implementation tools such as the capital improvement program or capital improvement budget. The result, therefore, has been the production, in many instances, of less than adequate planning guides when gauged against today's mandates for sound land use planning and development within a carrying capacity context.

Through legislative amendments and administrative action, the 701 program has become the basic federal grant program for most planning agencies. Eligible recipients now include localities of all sizes, counties, metropolitan and regional planning agencies, councils of government, states, specialized agencies such as transportation planning organizations and interstate agencies. Kentucky was one of the first states to institute substate regionalism with the creation of fifteen Area Development Districts (ADD's), all of which rely heavily on the 701 program for funding. The avowed functions of Kentucky's Area Development Districts are to:

(1) Provide needed technical assistance to local governments;

(2) Coordinate state and federal efforts to assist communities;

(3) Review and coordinate local development proposals; and,

(4) Conduct the necessary research and studies and coordinate and cooperate with all appropriate groups and agencies in order to develop, and adopt and revise, when necessary, a district development plan or series of plans, including, but not limited to, the following district-wide plan elements: goals and objectives; water and sewer; land use; and open space and recreation. Such plans shall serve as a general guide for public and private actions and decisions to assure the development of public and private property in the most appropriate relationships (76 & 77).

With regard to land use planning, it is believed that the following accurately reflects the current situation with Kentucky's ADD's.

> With a few widely scattered exceptions, substate regionalism has not produced a viable approach to land use planning. The areawide planning bodies are usually entirely advisory agencies, with no direct tie to any level of government which has executive or legislative functions. Neither local nor state governments have felt it necessary to follow, or even to receive the advice of an amorphous group not responsible to them, and to which they are not directly responsible, and which has a territorial "jurisdiction" which does not coincide with that of any elected official.
>
> This situation typically forces areawide agencies to devote their efforts almost entirely to the preparation of plans, and to play little or no role in plan implementation (40).

The major deficiency with regional planning agencies is their lack of legislative authority to implement plans. However, few if any regional agencies or states have taken the necessary action, that being the creation of areawide governments, to implement areawide plans.

One of the fundamental issues which must be resolved in any effort to improve land use planning in not only Kentucky, but also throughout the United States is the heavy reliance of local government on property taxes for a major share of their tax revenues. With the current situation, property taxes play a significant role in almost every land use decision made at the local level. So long as the property tax provides the major share of operating revenues for local governments, land use decisions will in all likelihood continue to be made on the basis of economic consideration rather than land capability.

Possible alternatives to the local property tax which have been offered by knowledgeable persons include:

(1) Broadening the base of local and state taxation through greater use of personal income and general sales taxes;

(2) Creation of areawide tax jurisdictions;

(3) Expansion of federal and implementation of state revenue sharing; and,

(4) Use of alternative revenue sources such as user charges (40).

Federal Role

The federal government provides extensive assistance to states and local governments and other agencies and organizations in the form of grants, loans, guarantees and technical assistance programs, many of which relate and impact upon the way in which land is developed and used.

The large number of assistance programs, the wide and diverse activities which they support and the number of federal, state and local agencies involved in their administration presents an extremely difficult task in attempting to formulate and administer comprehensive land use planning programs at the state and local levels. Further, federal economic development policies and programs are sometimes in conflict with environmental policies and programs which in turn reflect the lack of an adopted set of comprehensive national goals and policies.

Although there is not on record a coordinated comprehensive set of national goals and policies, increasing emphasis has been placed in recent years on environmental consequences of federal actions. With the enactment of the National Environmental Policy Act of 1969, all federal and federally related actions having possible major effects on the environment are to be undertaken only after the preparation and filing of an Environmental Impact Statement. The Act affects all levels of the federal government as well as other activities which may be financed or connected with the expenditure of federal funds.

The National Environmental Policy Act also provides for the establishment of a National Council on Environmental Quality (CEQ). CEQ is responsible for formulating Impact Statement Guidelines and reviewing and commenting on Impact Statements. However, CEQ has no authority to approve or disapprove Impact Statements or to order the cessation of project activity. CEQ may only rule upon the adequacy of an Impact Statement. Only the President can order a halt to construction.

Sixteen states have taken similar action and require the preparation and filing of Impact Statements for non-federal development. However, Kentucky has not taken such action. Requirements for Environmental Impact Statements generally include an analysis of the adverse and beneficial effects of the proposed development on people, animals, fish and vegetation in the area. Impact Statements generally require suggestions for ways to avoid or minimize adverse environmental effects and indicate alternatives to the proposed action.

In recent years Congress has spent considerable time in debating proposed federal land use legislation, and while a federal land use bill has yet to pass both houses of Congress, it is likely that before too long a land use bill will be placed on the statute books.

The land use bill which has come closest to passage called for land use decisions to be made on the basis of impact. Purely local decisions which affect only the local community would continue to be made by local public officials and local citizens. The American Law Institute estimates that nearly 90 percent of land use decisions are of purely local impact and significance, leaving only 10 percent to regional, state and federal review.

In the various land use bills which have been considered by Congress, the following provisions are generally included:

(1) Designation of a state planning agency with planning staff and authority to compile a data base for planning, develop a land use planning program and coordinate its activities with local, state and federal planning and pollution control agencies;

(2) Inventories of land and natural resources including projections of land needed and suitable for development to meet economic and social needs; and,

(3) Development of methodologies to control use and development of land of more than local significance due to its size, environmental impact or potential to induce growth.

Five critical land use areas are generally designated for control in most of the proposed land use bills:

(1) Areas of critical environmental concern, including historical or ecologically fragile lands, land subject to flooding and other natural disasters and regionally significant agricultural and watershed lands;

(2) Key facilities including those public facilities which tend to induce development or urbanization of more than local impact including airports, highway interchanges, recreational areas and energy facilities;

(3) Development of public facilities or utilities of regional benefit - including development of methods to assure that local regulations do not arbitrarily or capriciously exclude development of public facilities, housing or utilities of regional benefit;

(4) Large-scale private developments such as shopping centers, large subdivisions or apartment complexes which have the potential of creating environmental problems or generating additional development; and,

(5) Land sales and development projects - large scale development more than 10 miles from a planning unit - second homes, vacation resorts and rural subdivisions.

The State Role

Many feel that states, with their existing powers and financing capabilities, are best suited for implementing comprehensive land use planning. A number of states have already initiated state level land use controls of a comprehensive nature, with two systems of controls generally employed. One involves state establishment of guidelines for and administrative review of local land use planning, zoning and regulatory controls (Florida and Oregon). A second approach involves direct state planning and control (Hawaii, Vermont and Maine).

At the state level in Kentucky neither comprehensive quality-of-life nor economic, social or related goals which include consideration of population densities, population distribution, development types or other general measures of carrying capacity have been developed to guide State actions. An Economic Development Commission and an Environmental Quality Commission have been established but each is apparently pursuing separate courses with little or no interface to insure compatibility among goals and purposes.

However, the Kentucky Environmental Economic Development Policy Project, a group appointed by the Legislative Research Commission and partially financed by the National Science Foundation, has recently suggested the establishment of a Kentucky Enviro-Economic Council. The council, to be appointed by the Governor, would seek ways to resolve conflicts between economic development and environmental protection and would be composed of representatives of business and industry, conservation, education, local and state government, labor and agriculture.

At the present time Kentucky has not enacted statewide land use planning. However, largely in anticipation of adoption of a National Land Use Planning Bill, the 1974 Kentucky General Assembly enacted a new section of KRS 147 which recognized the need for statewide land use planning:

> .... in order to protect the natural resources and environment of the Commonwealth, and to insure a water management system that will prevent, and reverse whenever necessary, the deterioration of water quality and provide optimum utilization of our limited water resources, and to facilitate orderly and well planned development and to protect the health, welfare, safety and quality of life of the residents of Kentucky, it is necessary to adequately plan for and guide growth and development within the Commonwealth. In order to accomplish these purposes, it is necessary that the Commonwealth of Kentucky establish land and water management policies to guide and coordinate state, interstate and local decisions relating to growth and development, and that such state land and water management policies should to the maximum possible extent be implemented by local governments through processes for the guidance of growth and development, and that all the existing rights of private property be preserved in accord with the constitution of Kentucky and the United States.

The Act also established a Council for Land Use Planning composed of 15 members appointed by the Governor and representing a balance of interests in the Commonwealth. The Council is to be the Kentucky agency to fulfill federal requirements for councils associated with federal programs designed to provide support for state land use planning functions.

The Council is to prepare by November 1, 1975, a report of work undertaken by the Council, and any findings, conclusions and recommendations including the structure of any state land use planning process, and methods for assuring the compatibility of any state land use planning legislation with National Land Use Planning Legislation. In addition, the report is to contain:

(1) Such proposals for changes in legislation as are recommended by the Council;

(2) Drafts of model development ordinances which will assist local governments in adopting development ordinances;

(3) Analyses of and comments on other relevant state and national commissioned studies and reports, and reports of public and private agencies;

(4) Review of and recommendations on the current status and effectiveness of local and regional planning agencies with regard to land and water management; and

(5) Such other findings and recommendations as the Council chooses to make.

With the establishmnet of the Council for Land Use Planning, the opportunity exists for Kentucky to begin taking positive steps to insure that land use planning decisions remain within their borders. However, action must be forthcoming soon, otherwise the authority for land use planning will ascend to a higher level.

The Federal Water Pollution Control Act Amendments of 1972 contain many provisions which could place the federal government in a position of arbitrating land use decisions within local communities. However, if local and state governments begin to reassert their rights and responsibilities for

wisely planning and guiding growth in their jurisdictional areas, it would seem that a far more satisfactory situation would exist. The monetary cost of regulating and directing land use decisions should be significantly less with local versus federal direction and, most importantly, local communities are best able to understand their own unique problems and needs.

Local units of government in Kentucky at the present time have sufficient legislative authority to keep development patterns and timing in concert with water management capabilities. The problem is that few communities have taken the bold initiative necessary to meet the current environmental challenges.

The major problem facing many communities experiencing growth pressures is how best to guide growth in keeping with the community's ability to provide public services and protect the environment, while at the same time respecting the rights of the individual landowner. At the heart of the problem is the taking issue - the determination of when compensation must be paid when one's property is regulated to insure orderly community growth and protection of fragile elements of the environment within an area.

As reported in the Taking Issue, prepared for the Council on Environmental Quality, statutory standards are currently being used in Great Britain to determine when compensation should be paid. Apparently this system has had success and has been favorably accepted by developers, environmentalists and planning officials and is worthy of intensive study for applicability to situations in the United States (8).

Additional techniques which are currently being advocated to achieve an equitable balance between the rights of property owners and the needs, abilities and capabilities of the larger community and of the environment include: (1) density rights transfer, whereby owners of land zoned for low density would be compensated for the loss of their right to build by owners of high density districts who require additional development rights to build to the legal limit; (2) preferential tax assessment for agricultural land to lessen the pressure to convert agricultural land on the urban fringe to urban use; and, (3) a system of compensable regulations proposed for the American Land Institute's Model Land Development Code.

In summary, both the state and local units of government need to take bold initiatives in examining innovative planning and growth management techniques so that equitable compromises can be established between the rights of property owners and the demands and needs of the larger community and the environment and to insure that the majority of land use decisions which are of only local concern, remain within the purview of the local community.

Within the Kentucky River Basin, communities which are experiencing growth pressures such as Lexington, Nicholasville, Richmond and Berea should examine some of the activities taking place elsewhere in the country and begin shaping programs which will place them in a leadership role in not only managing community growth, but also firmly establishing their rights and responsibilities for local decision-making.

Another land use activity occurring within the Kentucky River Basin which is having a significant impact on water quality is strip mining. The coal rich counties in the basin, including Perry, Letcher, Bell, Clay, Estill, Harlan, Knott, Knox, and Leslie, have experienced mining activity in the past and with the increased dependence of this country on coal, a doubling or tripling of mining activity is expected in the future.

Impacts on water quality resulting from strip mining include high storm water runoff from logging operations which often precede strip mining activity, erosion and siltation resulting from the actual mining activity and sedimentation problems from coal haul roads.

Kentucky has enacted strip mine legislation which is considered by many to be a model law. The Division of Reclamation within the Department for Natural Resources and Environmental Protection has been given responsibility for implementing these measures. The Division in turn has issued a number of regulations which detail strip mining standards and requirements, including "SMB-Rg-6: Backfilling, Grading, Reclamation and Method of Operation" which specifies such things as bench width, water impoundment standards, methods of reclamation and vegetative planting, and "SMR-Rg-11: Water Quality" which requires the construction and maintenance by the operator of collection basins, water retaining structures, diversion ditches and silt dams. However, implementation and enforcement of these regulations have been extremely uneven, resulting in water quality degradation in a number of areas. Therefore, if improvement in water quality in the Kentucky River Basin is to be achieved, these regulations must be enforced.

Additional State Statutes Affecting Land Use

Deferred Tax Law for Agricultural Land (KRS 132)

In 1969 the voters in the Commonwealth approved an amendment to the Constitution which provided for the assessment of agricultural and horticultural land according to its use for those purposes. Statutory provisions were enacted in 1970 to implement the constitutional provisions which provide that if a landowner adopts another land use he must pay a monetary penalty in the form of a higher assessment and the deferred taxes, predating the land use change for those years.

As of this time, this method of deferred taxation has not been particularly effective in achieving its original land planning purpose of preserving open space at the fringes of Kentucky's growing cities. However, provisions for strengthening the statute to achieve its original intent are currently being developed by an interim committee of the legislature.

Power Plant Siting Law (KRS 278.025)

In 1974 the Kentucky General Assembly enacted a new section of KRS 278 which requires that prior to the constructing of a facility for the generation of electricity to or for the public for compensation, a "certificate of environmental compatibility" must be obtained from the Public Service Commission.

Sanitation Districts (KRS 200.030)

Sanitation Districts may be formed in any county or across county lines to prevent and correct the pollution of streams, to regulate the flow of streams for sanitary purposes, or to provide for the collection and disposal of sewage and other liquid wastes. Cities may be included in these Districts.

Soil Conservation Districts (KRS 262.200)

Soil Conservation Districts may be formed to implement soil conservation practices at the local level. The areas of a District may cut across county lines and include cities or parts thereof.

Watershed Conservancy Districts (KRS 262.700)

Watershed Conservancy Districts may be created as subdivisions of Soil Conservation Districts to develop and execute programs pertaining to water usage, flood prevention and control, sediment damage and erosion control.

PUBLIC PARTICIPATION

INTRODUCTION

Congress has recognized the importance of public understanding and involvement in efforts to improve the environment. This recognization is specifically set forth in Public Law 92-500, Section 101(e). In recognization of this requirement, a Public Participation Subcommittee was established early in the river basin planning process. This subcommittee consisted of consultant members and state officials from the Department for Natural Resources and Environmental Protection and the Office for Local Government. The subcommittee delineated the public participation process into three levels: Level One - Information and Education, Level Two - Public Involvement, and Level Three - Public Hearing.

LEGAL REQUIREMENT

Public Law 92-500 specifies that "Public participation in the development, revision, and enforcement of any regulation, standard, effluent limitations, plan, or program established by the Administration or any State under this Act shall be provided for, encouraged, and assisted by the Administration and the States. The Administrator, in cooperation with the States, shall develop and publish regulations specifying minimum guidelines for public participation in such processes."

EPA Regulation 40CFR, Section 131.502 sets forth the following: "There shall be conducted, prior to the adoption or any substantive revision of the basin plan and after reasonable notice thereof, one of more public hearings on the proposed basin plan or on parts of the basin plan in accordance with EPA regulations promulgated pursuant to Section 101(e) of the Act."

"The term 'public hearing' refers to a hearing in which three basic elements of public participation are presented; total public disclosure, planning agency representation, and sufficient opportunity for expression of views by the public."

EPA Regulation 40CFR, Part 105, also provides guidelines for Public Participation in Water Pollution Control. Section 105.7 provides guidelines for the conduct of and notice of public hearings. In addition, Section 105.7 encourages agencies "to hold public meetings or workshops, jointly where feasible, on significant matters or proposed actions. Such meetings shall not supplant public hearings when such are required, and shall be informational in nature with opportunity for public response."

PUBLIC PARTICIPATION PROCESS

This process as outlined in the Introduction of this chapter was separated into three levels. Each level was aimed at fulfilling the requirements of the regulations and was designated to solicit input into the planning process so that public attitudes and concerns could be evaluated and reflected, where appropriate, in the recommendations contained in this report.

Level One: Information and Education

Level One coverage consisted of news articles prepared by publicity specialists in the Department for Natural Resources for distribution to the State's news media.

During the fall of 1974, two news articles describing the planning process were released and received publication in the Kentucky River Basin. One was published in the Office for Local Government's publication FOCUS and the other was released from the Kentucky Department for Natural Resources and Environmental Protection to the State's news media and published in several newspapers including THE LOUISVILLE TIMES, which has large circulation in the basin.

The Office for Local Government contacted the fifteen (15) Area Development District Boards and staff personnel for the purpose of introducing the river basin planning effort to local representatives and to inform the Boards of future river basin planning presentations to be made by designated planning consultants.

Level Two: Public Involvement

Level Two coverage consisted of planning data presentations to the Area Development District Boards by the appropriate consultants. In each case at least two consultants were involved in these presentations.

During these presentations the following general outline was followed:

I. Background
   - A. Review of Public Law 92-500
   - B. Press Release from EPA and Kentucky Department for Natural Resources and Environmental Protection
   - C. Relationships between and among the planning programs. (303(e), 402, 201 and 208)
   - D. Funding Levels (State and Federal)

II. Specific Basin Planning Process
   - A. State Role
   - B. Consultant Role
   - C. University Role

III. Conclusions
   - A. Outputs from the Basin Planning Program
   - B. Establishment of Priorities for funding of Pollution Abatement Measures

Consultants for the Kentucky River Basin plan were the lead consultants for making presentations to the Kentucky River Area Development District and the Bluegrass Area Development District. Presentations were made to the Bluegrass ADD on November 20, 1974 in Georgetown, Kentucky, and to the Kentucky River ADD on December 19, 1974 in Hazard, Kentucky.

In addition, the Kentucky River Basin consultant participated in the presentation given by W. E. Gates and Associates and Proctor, Davis and Ray to the Northern Kentucky Area Development District on January 23, 1974.

Key public officials are members of the Area Development District Boards, and include mayors of municipalities, county judges and other key public and private persons within the District boundaries. Comments from these meetings were considered in the further conduct of the planning effort and in the conclusions contained in this report.

A subsequent phase of the Level Two public participation effort was a workshop held in each river basin for the purpose of presenting interim findings to interested citizens and officials and requesting comments to be considered in the report.

Announcement of the statewide workship schedule was made in a news release from Frankfort and carried by numerous newspapers in the state. In addition, 188 individual letters of invitation were sent to representatives of the following organizations in the Kentucky River Basin:

Sierra Club
Audubon Society
League of Women Voters
League of Kentucky Sportsmen
Chambers of Commerce
Soil Conservation Service
Municipal Government and County Judges
ADD Districts
Health Departments
EQC Mailing List
Kentucky members ORSANCO and Ohio River Basin

The Kentucky River Basin workshop was held at Eastern Kentucky University, Richmond, Kentucky on June 3, 1975 and was chaired by Mrs. Jackie Swigart, Chairperson of Kentucky's Environmental Quality Commission. The workshop was attended by thrity-three persons representing local government, consulting engineers, utility companies, and citizen organizations. The session provided the opportunity to both inform and educate those in attendance as well as receive suggestions for changes in the content of this report. The workshop further served as background for the Level Three process. Prior to and following this workshop session, a number of articles addressing river basin planning appeared in newspapers with coverage throughout the Kentucky River Basin.

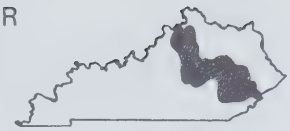
Level Three: Public Hearing

The official public hearing was conducted by the Division of Water Quality, Department for Natural Resources and Environmental Protection in Frankfort, Kentucky on June 27, 1975. The public hearing was attended by citizens, public officials and news media and covered all of the state's river basins. No information was presented at the public hearing to justify change in the recommendations contained herein.

APPENDIX A-1

WATER QUALITY DATA

KENTUCKY RIVER BASIN



Appendix A-1

Water Quality Data From Storet

Location		Water Quality Parameters						
		Specific Conductance μmho/cm	DO mg/1	pH Units	Suspended Solids mg/1	Ammonia mg/1	Total Phosphorous μg/ml	Total Coliform No./100 ml
Proposed Booneville Dam Site	(Max.)	250.00	13.80	7.50	14.00	0.11	150.00	900.00
	(Min.)	30.00	5.60	6.60	1.50	0.05	10.00	0.00
	(Avg.)	116.36	9.17	7.00	7.10	0.055	44.41	218.18
Buckhorn Lake	(Max.)	185.00	13.40	7.30	282.00	0.08	165.00	-
	(Min.)	49.00	7.40	6.50	4.00	0.08	165.00	-
	(Avg.)	108.00	9.58	6.86	63.28	0.08	165.00	-
Carr Fork Lake	(Max.)	390.00	12.80	7.90	159.00	0.90	190.00	650.00
	(Min.)	85.00	7.60	6.50	5.00	0.05	30.00	0.00
	(Avg.)	232.42	9.54	7.18	45.55	0.14	90.00	268.75
Proposed Eagle Creek Dam Site	(Max.)	660.00	11.40	8.20	550.00	0.13	1320.00	21000.00
	(Min.)	180.00	3.60	7.10	14.50	0.05	75.00	1400.00
	(Avg.)	372.36	7.81	7.64	92.89	0.081	393.25	5266.67
Proposed Red River Dam Site	(Max.)	13500.00	12.40	7.70	51.00	0.22	200.00	400.00
	(Min.)	35.00	6.30	6.60	3.00	0.05	10.00	0.00
	(Avg.)	621.44	9.18	7.11	22.67	0.062	61.69	166.67

USGS Water Quality Data

Appendix A-1

Water Year 1974 - Eagle Creek at Glencoe, Kentucky

Date	Average Water Quality Parameters						
	Dissolved Solids mg/1	Hardness (Ca, Mg) mg/1	Specific Conductance mho/1	pH Units	Total Phosphorous mg/1	Nitrate (NO-3) mg/1	Discharge (q) cfs
Oct.-Dec.	209.67	161.67	305.33	7.4	0.15	0.34	2,102.33
Jan.-Mar.	268.00	200.00	401.00	-	-	-	831.00
Apr.-June	281.00	203.50	430.00	-	0.25	0.26	2,121.33
July-Sept.	206.00	170.00	318.33	7.6	0.08	0.50	40.50

Appendix A-1

Water Year 1974 - Kentucky River at Lock No. 2

Date	Average Water Quality Parameters						
	Dissolved Solids mg/1	Hardness (Ca, Mg) mg/1	Specific Conductance mho/1	pH Units	Total Phosphorous mg/1	Nitrate (NO-3) mg/1	Discharge (q) cfs
Oct.-Dec.	170.75	122.50	271.75	7.42	0.14	-	2,216.50
Jan.-Mar.	135.67	92.00	200.00	-	0.13	-	32,640.00
Apr.-June	153.33	95.67	227.67	-	0.15	-	4,816.67
July-Sept.	158.33	113.33	242.50	7.2	0.37	-	12,833.33

Appendix A-1 Water Year 1970 - North Fork Kentucky River at Hazard

Date	Average Water Quality Parameters						
	Dissolved Solids mg/l	Hardness (Ca, Mg) mg/l	Specific Conductance mho/l	pH Units	Total Phosphorous mg/l	Nitrate (NO-3) mg/l	Discharge (q) cfs
Oct.-Dec.	456.40	220.60	619.33	7.24	-	1.80	75.83
Jan.-Mar.	236.40	101.20	334.00	7.36	-	1.96	461.83
Apr.-June	260.67	152.00	451.67	7.27	-	1.95	334.33
July-Sept.	447.60	239.20	662.50	7.56	0.12	1.84	80.60

Appendix A-1 Water Year 1970 - Kentucky River at Lock No. 4

Date	Average Water Quality Parameters						
	Dissolved Solids mg/l	Hardness (Ca, Mg) mg/l	Specific Conductance mho/l	pH Units	Total Phosphorous mg/l	Nitrate (NO-3) mg/l	Discharge (q) cfs
Oct.-Dec.	251.50	136.00	393.50	7.83	-	2.67	670.50
Jan.-Mar.	137.00	95.67	227.67	7.78	-	4.12	22,555.00
Apr.-June	139.00	92.67	221.83	7.38	-	3.20	20,798.33
July-Sept.	194.33	124.33	310.67	7.48	-	2.92	1,913.00

Appendix A-1 Water Year 1974 - Carr Fork near Sassafras, Kentucky

Date	Average Water Quality Parameters						
	Dissolved Solids mg/l	Hardness (Ca, Mg) mg/l	Specific Conductance mho/l	pH Units	Total Phosphorous mg/l	Nitrate (NO-3) mg/l	Discharge (q) cfs
Oct.-Dec.	261.50	165.00	385.00	7.55	0.04	2.30	17.95
Jan.-Mar.	176.50	110.00	281.50	-	0.005	0.49	50.00
Apr.-June	133.00	85.00	221.50	-	0.17	0.30	97.50
July-Sept.	235.00	155.00	353.50	-	0.025	0.41	15.25

Appendix A-1 Water Year 1974 - Red River near Pine Ridge, Kentucky

Date	Average Water Quality Parameters						
	Dissolved Solids mg/l	Hardness (Ca, Mg) mg/l	Specific Conductance mho/l	pH Units	Total Phosphorous mg/l	Nitrate (NO-3) mg/l	Discharge (q) cfs
Oct.-Dec.	72.67	45.33	124.33	7.23	0.01	0.17	45.33
Jan.-Mar.	47.50	22.50	67.50	-	-	0.14	52.00
Apr.-June	62.00	-	79.00	-	-	-	127.50
July-Sept.	81.00	44.50	96.50	-	0.025	0.12	86.00

Appendix A-1 Water Quality Data from USGS (Miscellaneous Sites)

Date	Location Site	Lat. (Long)	Water Quality Parameters: Dissolved Solids mg/l	Hardness (Ca, Mg) mg/l	Specific Conductance mho/l	pH Units	Total Phosphorous mg/l	Nitrate (NO-3) mg/l	Discharge (q) cfs
Water Year 1970 - North Fork Kentucky River									
Sept. 18	Whitesburg	37-07-03 (82-29-29)	624	315	962	7.6	0.10	1.0	3.4
Sept. 17	Corenttsville	37-07-43 (83-05-11)	364	208	589	7.5	0.00	1.0	9.0
Sept. 15	Jackson	37-33-05 (83-23-05)	288	182	456	7.0	0.03	1.2	114.0
Water Year 1970 - Troublesome Creek									
Sept. 16	Noble	37-26-36 (83-13-06)	332	216	488	7.0	0.20	1.1	3.9
Water Year 1970 - Quicksand Creek									
-	Lunah	37-33-31 (83-23-05)	119	77	195	7.1	0.02	1.2	2.2
Water Year 1970 - Middle Fork Kentucky River									
Sept. 17	Hyden	37-08-13 (83-22-17)	88	66	161	7.3	0.01	0.4	7.7
Sept. 14	Tallega	37-33-18 (83-35-38)	90	41	162	7.4	0.21	0.9	97.0
Water Year 1970 - Cutshin Creek									
Sept. 17	Wooton	37-09-54 (83-22-17)	156	110	277	7.1	0.03	1.6	1.9
Water Year 1970 - Red Bird River									
Sept. 17	Big Creek	37-09-24 (83-35-38)	109	71	182	7.0	0.02	0.5	-
Water Year 1970 - Goose Creek									
Sept. 14	Manchester	37-09-07 (83-45-37)	138	88	257	6.6	0.03	1.4	18
Water Year 1970 - South Fork Kentucky River									
Sept. 14	Oneida	37-16-23 (83-38-50)	212	130	364	6.8	0.15	1.6	60
Sept. 15	Booneville	37-28-45 (83-40-38)	162	100	304	7.3	0.03	1.1	95
Water Year 1970 - Kentucky River									
Sept. 15	Lock 14 at Heidelberg	37-33-19 (83-46-06)	150	100	258	7.0	0.09	1.6	-

Appendix A-1 Water Quality Data from USGS (Miscellaneous Sites)

Date	Location Site	Lat. (Long)	Water Quality Parameters: Dissolved Solids mg/l	Hardness (Ca, Mg) mg/l	Specific Conductance mho/l	pH Units	Total Phosphorous mg/l	Nitrate (NO-3) mg/l	Discharge (q) cfs
Water Year 1970 - Station Camp Creek									
Sept. 15	Wagerville	37-37-15 (83-57-34)	154	126	285	7.4	0.00	1.3	2.4
Water Year 1970 - Red River									
Sept. 15	Clay City	37-51-52 (83-55-59)	133	71	214	7.7	0.07	1.9	87
Water Year 1970 - Benson Creek									
Sept. 30	Frankfort	38-12-11 (84-52-56)	262	191	394	7.9	-	3.3	13
Water Year 1970 - South Elkhorn Creek									
Sept. 30	Fort Spring	38-02-35 (84-37-35)	280	239	501	7.8	1.3	13	9.6
Water Year 1970 - North Fork Kentucky River									
Sept. 26	Blackey	37-07-43 (82-58-27)	392	220	574	-	0.02	0.00	31
June 12	Jackson	37-33-05 (83-23-05)	251	-	351	7.4	-	-	-
Water Year 1974 - Leatherwood Creek									
Sept. 26	Daisy	37-06-48 (83-05-33)	172	110	268	-	0.02	0.01	11
Water Year 1974 - Quicksand Creek									
Sept. 26	Quicksand	37-32-11 (83-20-55)	112	85	186	-	0.02	0.11	36
Water Year 1974 - Middle Fork Kentucky River									
June 12	Hyden	37-08-13 (83-22-17)	59	-	87	7.3	-	-	-
June 12	Tallega	37-33-18 (83-35-38)	82	-	112	-	-	-	-
Water Year 1974 - Cutshin Creek									
June 12	Wooton	37-09-54 (83-18-29)	143	-	218	7.5	-	-	-
Water Year 1974 - Red Bird River									
Aug. 27	Big Creek	37-10-43 (83-35-35)	162	87	146	-	0.16	0.04	6.7

Appendix A-1 Water Quality Data from USGS (Miscellaneous Sites)

Date	Location Site	Lat. (Long)	Water Quality Parameters: Dissolved Solids mg/l	Hardness (Ca, Mg) mg/l	Specific Conductance mho/l	pH Units	Total Phosphorous mg/l	Nitrate (NO-3) mg/l	Discharge (q) cfs
Water Year 1974 - Silver Creek									
Oct. 30	Richmond	37-42-36 (84-27-48)	280	200	422	8.1	0.20	0.39	20
Aug. 1	"	"	184	140	265	8.8	0.08	0.21	4.1
Water Year 1974 - Dix River									
Oct. 30	Stanford	37-33-18 (84-36-10)	210	190	349	7.5	0.07	0.26	0.50
Water Year 1974 - Hanging Fork Creek									
July 31	Stanford	37-32-44 (84-43-42)	246	190	343	7.6	-	0.41	0.46
Water Year 1974 - Eagle Creek									
Aug. 1	Holbrook	38-38-11 (84-42-21)	238	230	326	7.7	-	0.11	9.1

POPULATION DISAGGREGATION

Introduction

The number of people living within a community or an area represent one factor in the process of determining wastewater loads. Therefore, information in this appendix was developed in order to determine the number of people projected to live within the Kentucky River Basin and its individual segments for 1975, 1980 and 1995.

For control purposes and to maintain consistency throughout each of the Kentucky's river basins, county population projections and urban area percentages developed by the Kentucky Program Development Office in 1972 were utilized. These projections were then disaggregated to determine future population within the Kentucky River Basin and within each of its fifty-nine (59) segments.

EXHIBIT A-2.1t provides "at-year" actual or projected population trends and projections for each of the thirty-nine Kentucky River Basin Counties, the number of persons living outside the basin and the number of people living inside the basin, including a breakdown between urban, rural, farm and non-farm population. Finally, EXHIBIT A-2.1t also gives a between year percentage change for each category. Similar data by segment is presented in Appendix B.

EXHIBIT A-2.2t provides population density figures for each of the thirty-nine counties within the Kentucky River Basin along with urban and rural density figures for the county areas within the basin.

Exhibit A-2.1t Population Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Population				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Thirty-Nine County Total	789,142	830,931	881,463	1,065,902	5.3	6.0	20.9
Out of Basin	251,358	261,068	274,298	326,764	3.8	5.1	19.1
In Kentucky River Basin	537,784	569,863	607,165	739,138	5.9	6.5	21.7
Urban	260,777	293,496	327,275	452,302	12.5	11.5	38.2
Rural	277,007	276,367	279,594	282,836	- 0.2	2.4	2.4
Farm	250,759	248,366	249,682	247,908	- 0.9	0.6	0.7
Non-Farm	26,248	28,001	29,912	34,928	6.2	6.8	16.7
Anderson County	9,358	9,798	10,296	12,136	4.5	10.4	9.8
Out of Basin	8,498	8,593	8,979	10,650	1.1	4.3	15.7
In Kentucky River Basin	860	1,205	1,317	1,486	28.6	8.5	11.4
Urban	-	-	-	-	-	-	-
Rural	860	1,205	1,317	1,486	28.6	8.5	11.4
Farm	860	1,205	1,317	1,486	28.6	8.5	11.4
Non-Farm	-	-	-	-	-	-	-
Bell County	31,087	31,308	31,572	31,933	0.7	0.8	1.1
Out of Basin	29,968	30,181	30,435	30,784	0.7	0.8	1.1
In Kentucky River Basin	1,119	1,127	1,137	1,149	0.7	0.9	1.0
Urban	-	-	-	-	-	-	-
Rural	1,119	1,127	1,137	1,149	0.7	0.9	1.0
Farm	1,119	1,127	1,137	1,149	0.7	0.9	1.0
Non-Farm	-	-	-	-	-	-	-
Boone County	32,812	38,054	44,538	72,315	13.8	14.5	38.4
Out of Basin	31,943	37,178	43,635	71,454	14.1	14.8	38.9
In Kentucky River Basin	869	876	903	861	0.8	3.0	4.9
Urban	-	-	-	-	-	-	-
Rural	869	876	903	861	0.8	3.0	-4.9
Farm	869	876	903	861	0.8	3.0	-4.9
Non-Farm	-	-	-	-	-	-	-
Boyle County	21,090	21,416	21,767	22,763	1.5	1.6	4.4
Out of Basin	5,412	4,974	5,069	5,190	8.8	1.9	2.3
In Kentucky River Basin	15,678	16,442	16,698	17,573	4.6	1.5	5.0
Urban	11,542	11,871	12,500	14,750	2.8	5.0	15.2
Rural	4,136	4,571	4,198	2,823	9.5	- 8.9	-48.7
Farm	3,089	3,510	3,123	1,623	12.0	-12.4	-92.4
Non-Farm	1,047	1,061	1,075	1,200	1.3	1.3	10.4

Exhibit A-2.1t Population Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Population				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Breathitt County	14,221	14,409	14,830	16,085	1.3	2.8	7.8
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	14,221	14,409	14,830	16,085	1.3	2.8	7.8
Urban	-	-	-	-	-	-	-
Rural	14,221	14,409	14,830	16,085	1.3	2.8	7.8
Farm	12,334	12,516	12,930	14,115	1.4	3.2	8.4
Non-Farm	1,887	1,893	1,900	1,970	0.3	0.4	3.5
Carroll County	8,523	8,863	9,262	10,850	3.8	4.3	14.6
Out of Basin	1,647	1,715	1,824	1,719	4.0	5.9	6.1
In Kentucky River Basin	6,876	7,148	7,438	9,131	3.8	4.0	18.5
Urban	3,884	3,992	4,100	6,004	2.7	2.6	31.7
Rural	2,992	3,156	3,338	3,127	2.3	5.4	-6.7
Farm	2,214	2,328	2,460	2,124	4.8	5.3	-15.8
Non-Farm	778	828	878	1,003	6.0	5.7	12.4
Casey County	12,930	12,781	12,644	11,989	1.1	1.1	6.1
Out of Basin	12,835	12,688	12,552	11,906	1.1	1.1	5.4
In Kentucky River Basin	95	93	92	83	-2.1	-1.1	-10.8
Urban	-	-	-	-	-	-	-
Rural	95	93	92	83	-2.1	-1.1	-10.8
Farm	95	93	92	83	-2.1	-1.1	-10.8
Non-Farm	-	-	-	-	-	-	-
Clark County	24,090	25,964	28,152	36,218	7.2	7.8	22.3
Out of Basin	17,883	19,487	21,391	27,467	8.2	8.9	22.1
In Kentucky River Basin	6,207	6,477	6,761	8,751	4.7	4.2	22.7
Urban	-	-	-	-	-	-	-
Rural	6,207	6,477	6,761	8,751	4.7	4.2	22.7
Farm	6,207	4,477	6,761	8,751	4.7	4.2	22.7
Non-Farm	-	-	-	-	-	-	-
Clay County	18,481	17,955	17,439	15,108	2.9	2.9	15.4
Out of Basin	843	956	890	771	11.8	7.4	15.4
In Kentucky River Basin	17,638	17,039	16,549	14,337	3.5	2.9	15.4
Urban	-	-	-	-	-	-	-
Rural	17,638	17,039	16,549	14,337	3.5	2.9	15.4
Farm	15,974	15,247	14,629	12,289	-4.7	-4.2	-19.0
Non-Farm	1,664	1,792	1,920	2,048	7.1	6.7	6.2
Estill County	12,752	13,257	13,886	16,383	3.8	4.5	15.2
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	12,752	13,257	13,886	16,383	3.8	4.5	15.2
Urban	3,702	3,988	4,276	5,526	7.2	6.7	22.6
Rural	9,050	9,269	9,610	10,857	2.3	3.5	11.5
Farm	9,050	9,269	9,610	10,857	2.3	3.5	11.5
Non-Farm	-	-	-	-	-	-	-
Fayette County	174,323	193,024	214,352	291,598	9.7	9.9	26.5
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	174,323	193,024	214,352	291,598	9.7	9.9	26.5
Urban	161,710	183,372	203,633	277,018	4.7	9.9	26.5
Rural	12,613	9,652	10,719	14,580	-30.7	9.9	-26.5
Farm	12,613	9,652	10,719	14,580	-30.7	9.9	-26.5
Non-Farm	-	-	-	-	-	-	-
Franklin County	34,481	36,925	39,648	48,872	6.6	6.3	18.8
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	34,481	36,925	39,648	48,872	6.6	6.3	18.8
Urban	21,356	24,012	27.606	40,207	11.0	13.0	31.3
Rural	13,125	12,913	12,042	8,665	-1.6	-8.3	-38.9
Farm	13,125	12,913	12,042	8,665	-1.6	-8.3	-38.9
Non-Farm	-	-	-	-	-	-	-
Gallatin County	4,134	4,492	4,932	6,787	7.9	8.9	27.3
Out of Basin	3,350	3,612	3,763	5,478	7.2	4.0	31.3
In Kentucky River Basin	784	880	1,169	1,309	10.9	24.7	10.7
Urban	-	-	-	-	-	-	-
Rural	784	880	1,169	1,309	10.9	24.7	10.7
Farm	616	712	1,001	1,141	13.5	28.8	12.3
Non-Farm	168	168	168	168	0	0	0

Exhibit A-2.1t Population Trends and Projections, 1970-1995 For the Kentucky River Basin

Area of Coverage	At Year Actual or Projected Population				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Garrard County	9,457	9,601	9,848	10,676	1.5	2.5	7.7
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	9,457	9,601	9,848	10,676	1.5	2.5	7.7
Urban	3,230	3,426	3,662	4,450	5.7	6.4	17.7
Rural	6,227	6,175	6,186	6,226	0.8	0.2	0.6
Farm	6,227	6,175	6,186	6,226	0.8	0.2	0.6
Non-Farm	-	-	-	-	-	-	-
Grant County	9,999	10,311	10,704	12,353	3.0	3.7	13.3
Out of Basin	1,992	1,991	2,039	2,306	0	2.3	11.6
In Kentucky River Basin	8,007	8,320	8,665	10,047	3.7	4.0	13.7
Urban	-	-	-	-	-	-	-
Rural	8,007	8,320	8,665	10,047	3.7	4.0	13.7
Farm	4,249	4,319	4,419	4,961	1.6	2.2	10.9
Non-Farm	3,758	4,001	4,246	5,086	6.0	5.8	16.5
Harlan County	37,370	36,760	36,084	33,142	1.6	1.9	8.8
Out of Basin	33,288	32,753	32,153	29,529	4.7	1.8	8.9
In Kentucky River Basin	4,082	4,007	3,931	3,613	1.8	1.9	8.1
Urban	-	-	-	-	-	-	-
Rural	4,082	4,007	3,931	3,613	-1.8	-1.9	-8.1
Farm	4,082	4,007	3,931	3,613	-1.8	-1.9	-8.1
Non-Farm	-	-	-	-	-	-	-
Henry County	10,910	11,421	12,066	14,842	4.5	5.3	18.7
Out of Basin	3,671	3,898	4,139	4,989	5.8	5.8	17.0
In Kentucky River Basin	7,239	7,523	7,927	9,853	3.8	5.1	19.5
Urban	-	-	-	-	-	-	-
Rural	7,239	7,523	7,927	9,853	3.8	5.1	19.5
Farm	6,135	5,959	6,322	8,088	2.9	5.7	21.8
Non-Farm	1,104	1,564	1,605	1,765	29.4	2.5	9.0
Jackson County	10,005	10,518	11,189	13,889	4.9	6.0	19.4
Out of Basin	5,606	5,838	6,210	7,709	4.0	6.0	19.4
In Kentucky River Basin	4,399	4,680	4,979	6,180	6.0	6.0	19.4
Urban	-	-	-	-	-	-	-
Rural	4,399	4,680	4,979	6,180	6.0	6.0	19.4
Farm	4,399	4,680	4,979	6,180	6.0	6.0	19.4
Non-Farm	-	-	-	-	-	-	-
Jessamine County	17,430	19,543	22,000	31,725	10.8	11.1	30.6
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	17,430	19,543	22,000	31,725	10.8	11.1	30.6
Urban	9,295	11,684	14,583	27,216	20.4	19.8	46.4
Rural	8,135	7,859	7,417	4,509	-3.5	-5.9	-39.2
Farm	8,135	7,859	7,417	4,509	-3.5	-5.9	-39.2
Non-Farm	-	-	-	-	-	-	-
Knott County	14,698	14,628	14,883	15,163	0.5	1.4	2.7
Out of Basin	4,101	3,946	3,797	3,154	3.9	-3.9	-20.4
In Kentucky River Basin	10,597	10,682	11,036	12,009	0.8	3.2	8.1
Urban	-	-	-	-	-	-	-
Rural	10,597	10,682	11,036	12,009	0.8	3.2	8.1
Farm	9,789	9,778	10,036	10,784	0.1	2.6	6.9
Non-Farm	808	904	1,000	1,225	10.6	9.6	18.3
Knox County	23,689	23,889	24,124	24,449	0.8	1.0	1.3
Out of Basin	21,394	21,571	21,783	22,077	0.8	1.0	1.3
In Kentucky River Basin	2,295	2,318	2,341	2,372	1.0	1.0	1.3
Urban	-	-	-	-	-	-	-
Rural	2,295	2,318	2,341	2,372	1.0	1.0	1.3
Farm	2,295	2,318	2,341	2,372	1.0	1.0	1.3
Non-Farm	-	-	-	-	-	-	-
Lee County	6,587	6,458	6,378	6,080	2.0	1.2	4.9
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	6,587	6,458	6,378	6,080	2.0	1.2	4.9
Urban	-	-	-	-	-	-	-
Rural	6,587	6,458	6,378	6,080	-2.0	-1.2	-4.9
Farm	5,664	5,535	5,455	5,157	-2.3	-1.4	-5.8
Non-Farm	923	923	923	923	0	0	0

Exhibit A-2.1t Population Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Population				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Leslie County	11,623	11,962	12,342	13,152	2.8	3.1	6.1
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	11,623	11,962	12,342	13,152	2.8	3.1	6.1
Urban	-	-	-	-	-	-	-
Rural	11,623	11,962	12,342	13,152	2.8	3.1	6.1
Farm	11,141	11,405	11,710	12,070	2.3	2.6	3.0
Non-Farm	482	557	632	1,082	13.4	11.9	41.6
Letcher County	23,165	22,446	21,627	19,487	3.2	3.8	18.3
Out of Basin	3,432	3,349	3,142	3,715	2.5	6.6	15.4
In Kentucky River Basin	19,733	19,097	18,485	15,772	3.3	3.3	17.2
Urban	-	-	-	-	-	-	-
Rural	19,733	19,097	18,485	15,772	3.3	3.3	17.2
Farm	16,381	15,745	15,133	12,420	-4.0	-4.0	-21.8
Non-Farm	3,352	3,352	3,352	3,352	-	-	-
Lincoln County	16,663	17,072	17,956	19,566	2.4	4.9	8.2
Out of Basin	5,313	5,386	5,694	6,082	1.3	5.4	6.4
In Kentucky River Basin	11,350	11,686	12,262	13,484	2.8	4.7	9.0
Urban	2,474	2,575	2,675	3,112	3.9	3.7	14.0
Rural	8,876	9,111	9,587	10,372	2.6	4.9	7.6
Farm	7,602	7,800	8,238	8,887	2.5	5.3	7.3
Non-Farm	1,274	1,311	1,349	1,485	2.8	2.8	9.1
Madison County	42,730	46,217	50,118	63,481	7.5	7.8	21.0
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	42,730	46,217	50,118	63,481	7.5	7.8	21.0
Urban	23,817	27,124	30,918	44,785	12.2	12.3	30.9
Rural	18,913	19,093	19,200	18,696	0.9	0.5	2.7
Farm	18,913	19,093	19,200	18,696	0.9	0.5	2.7
Non-Farm	-	-	-	-	-	-	-
Menifee County	4,050	4,070	4,083	4,132	0.5	0.3	1.2
Out of Basin	2,713	2,728	2,733	2,782	0.5	0.2	1.7
In Kentucky River Basin	1,337	1,342	1,350	1,350	0.4	0.6	0
Urban	-	-	-	-	-	-	-
Rural	1,337	1,342	1,350	1,350	0.4	0.6	0
Farm	1,337	1,342	1,350	1,350	0.4	0.6	0
Non-Farm	-	-	-	-	-	-	-
Mercer County	15,960	16,950	18,089	22,529	5.8	6.3	19.7
Out of Basin	12,368	13,072	13,906	17,209	5.4	6.0	19.2
In Kentucky River Basin	3,592	3,878	4,183	5,320	7.4	7.3	21.4
Urban	-	-	-	-	-	-	-
Rural	3,592	3,878	4,183	5,320	7.4	7.3	21.4
Farm	2,590	2,826	3,083	4,070	8.3	8.3	24.2
Non-Farm	1,002	1,052	1,100	1,250	4.7	4.3	-12.0
Montgomery County	15,364	16,714	18,281	24,358	8.1	8.6	24.9
Out of Basin	14,071	15,251	16,621	21,936	7.7	8.2	24.2
In Kentucky River Basin	1,293	1,463	1,660	2,422	11.6	11.8	31.4
Urban	-	-	-	-	-	-	-
Rural	1,293	1,463	1,660	2,422	11.6	11.8	31.4
Farm	1,293	1,463	1,660	2,422	11.6	11.8	31.4
Non-Farm	-	-	-	-	-	-	-
Owen County	7,470	7,460	7,564	7,983	0.1	1.4	5.2
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	7,470	7,460	7,564	7,983	0.1	1.4	5.2
Urban	-	-	-	-	-	-	-
Rural	7,470	7,460	7,564	7,983	0.1	1.4	5.2
Farm	5,880	5,837	5,909	6,228	0.7	1.2	5.1
Non-Farm	1,590	1,623	1,655	1,755	2.0	1.9	5.7

Exhibit A-2.1t Population Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Population				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Owsley County	5,023	4,944	4,999	5,161	1.5	1.1	3.1
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	5,023	4,944	4,999	5,161	1.5	1.1	3.1
Urban	-	-	-	-	-	-	-
Rural	5,023	4,944	4,999	5,161	1.5	1.1	3.1
Farm	4,897	4,818	4,873	5,035	5.4	1.1	3.2
Non-Farm	126	126	126	126	-	-	-
Perry County	26,259	25,140	24,441	21,280	4.4	2.8	14.8
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	26,259	25,140	24,441	21,280	4.4	2.8	14.8
Urban	5,459	5,459	5,459	5,459	0	0	0
Rural	20,800	19,681	18,982	15,821	5.7	3.7	19.9
Farm	20,423	19,304	18,605	15,444	-5.8	-3.7	-20.4
Non-Farm	377	377	377	377	-	-	-
Powell County	7,704	8,239	8,850	10,992	6.5	6.9	19.5
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	7,704	8,239	8,850	10,992	6.5	6.9	19.5
Urban	-	-	-	-	-	-	-
Rural	7,704	8,239	8,850	10,992	6.5	6.9	19.5
Farm	4,684	4,804	4,459	4,939	2.5	7.7	9.7
Non-Farm	3,020	3,435	4,391	6,053	12.1	21.7	27.4
Rockcastle County	12,305	12,906	13,631	16,360	4.6	5.3	16.7
Out of Basin	11,166	11,370	12,008	14,413	1.8	5.3	16.7
In Kentucky River Basin	1,139	1,536	1,623	1,947	25.8	5.3	16.6
Urban	-	-	-	-	-	-	-
Rural	1,139	1,536	1,623	1,947	25.8	5.3	16.6
Farm	1,139	1,536	1,623	1,947	25.8	5.3	16.6
Non-Farm	-	-	-	-	-	-	-
Scott County	17,948	18,749	19,608	22,444	4.1	4.4	12.6
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	17,948	18,749	19,608	22,444	4.1	4.4	12.6
Urban	8,629	9,264	9,900	11,978	6.8	6.4	17.3
Rural	9,319	9,485	9,708	10,466	1.7	2.3	7.2
Farm	8,908	9,049	9,248	9,664	1.5	2.1	4.3
Non-Farm	411	436	460	802	5.7	5.2	42.6
Shelby County	18,999	19,892	20,973	25,216	4.5	5.1	16.8
Out of Basin	16,769	17,383	18,325	21,991	3.6	5.1	16.7
In Kentucky River Basin	2,230	2,509	2,648	3,225	11.1	5.2	17.9
Urban	-	-	-	-	-	-	-
Rural	2,230	2,509	2,648	3,225	11.1	5.2	17.9
Farm	2,230	2,509	2,648	3,225	11.1	5.2	17.9
Non-Farm	-	-	-	-	-	-	-
Trimble County	5,349	5,487	5,637	6,148	2.5	2.6	8.3
Out of Basin	3,095	3,148	3,210	3,453	1.7	1.9	7.0
In Kentucky River Basin	2,254	2,339	2,427	2,695	3.6	3.6	9.9
Urban	-	-	-	-	-	-	-
Rural	2,254	2,339	2,427	2,695	3.6	3.6	9.9
Farm	1,474	1,499	1,527	1,645	1.7	1.8	7.1
Non-Farm	780	840	900	1,050	7.1	6.6	14.3
Wolfe County	5,669	5,615	5,663	5,828	1.0	0.8	2.8
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	5,669	5,615	5,663	5,828	1.0	0.8	2.8
Urban	-	-	-	-	-	-	-
Rural	5,669	5,615	5,663	5,828	1.0	0.8	2.8
Farm	5,250	5,196	5,208	5,250	1.0	0.2	0.8
Non-Farm	419	419	455	578	0	7.9	21.3
Woodford County	14,434	15,653	17,057	22,429	7.8	8.2	23.9
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	14,434	15,653	17,057	22,429	7.8	8.2	23.9
Urban	5,679	6,729	7,963	11,817	15.6	15.5	32.6
Rural	8,755	8,924	9,094	10,612	1.9	1.8	14.3
Farm	7,477	7,585	7,694	8,987	1.4	1.4	14.4
Non-Farm	1,278	1,339	1,400	1,625	4.5	4.3	13.8

Exhibit A-2.2t - County and Sub-Area Population Density (1970 - 1995)

Area Breakdown	Persons Per Square Mile			
	1970	1975	1980	1995
State of Kentucky	76.70	83.94	88.18	105.81
Anderson County Total	45.43	47.56	49.98	58.91
Inside Kentucky River Basin	28.19	39.51	43.18	48.72
Urban	-	-	-	-
Rural	28.19	39.51	43.18	48.72
Bell County Total	84.04	84.64	85.35	86.33
Inside Kentucky River Basin	86.07	86.69	87.46	88.38
Urban	-	-	-	-
Rural	86.07	86.69	87.46	88.38
Boone County Total	131.61	152.64	178.65	290.07
Inside Kentucky River Basin	75.56	76.17	78.52	74.87
Urban	-	-	-	-
Rural	75.56	76.17	78.52	74.87
Boyle County Total	115.06	116.83	118.75	124.18
Inside Kentucky River Basin	221.75	232.56	236.18	248.56
Urban	3,335.84	3,334.55	3,333.33	3,337.10
Rural	61.51	68.08	62.70	42.59
Breathitt County Total	28.79	29.17	30.02	46.08
Inside Kentucky River Basin	28.79	29.17	30.02	46.08
Urban	-	-	-	-
Rural	28.79	29.17	30.02	46.08
Carroll County Total	65.56	68.18	71.25	83.46
Inside Kentucky River Basin	79.22	82.35	85.69	105.19
Urban	2,298.22	2,307.51	2,070.71	2,318.15
Rural	35.15	37.10	39.35	37.13
Casey County Total	29.72	29.38	29.07	27.56
Inside Kentucky River Basin	25.67	25.13	24.86	22.43
Urban	-	-	-	-
Rural	25.67	25.13	24.86	22.43
Clark County Total	93.01	100.25	108.69	139.84
Inside Kentucky River Basin	41.49	43.29	45.19	58.49
Urban	-	-	-	-
Rural	41.49	43.29	45.19	58.49
Clay County Total	38.99	37.88	36.79	31.87
Inside Kentucky River Basin	39.19	37.86	36.77	31.86
Urban	-	-	-	-
Rural	39.19	39.19	39.19	39.19
Estill County Total	49.05	50.99	53.41	63.01
Inside Kentucky River Basin	49.05	50.99	53.41	63.01
Urban	2,271.16	2,278.86	2,286.63	2,292.95
Rural	35.03	35.89	37.23	42.15
Fayette County Total	622.14	688.88	764.99	1,040.68
Inside Kentucky River Basin	622.14	688.88	764.99	1,040.68
Urban	5,191.33	5,191.73	5,192.07	5,192.46
Rural	50.64	39.41	44.48	64.27
Franklin County Total	163.42	175.00	187.90	231.62
Inside Kentucky River Basin	163.42	175.00	187.90	231.62
Urban	3,113.12	3,114.39	3,115.80	3,788.53
Rural	64.29	63.52	59.57	43.74
Gallatin County Total	41.51	45.10	49.52	68.14
Inside Kentucky River Basin	35.64	40.00	53.14	59.50
Urban	-	-	-	-
Rural	35.64	40.00	53.14	59.50

Exhibit A-2.2t - County and Sub-Area Population Density (1970 - 1995)

Area Breakdown	Persons Per Square Mile			
	1970	1975	1980	1995
Garrard County Total	40.00	40.61	41.66	45.16
Inside Kentucky River Basin	40.00	40.61	41.66	45.16
Urban	2,523.44	2,519.12	2,525.52	2,528.41
Rural	26.48	26.27	26.33	26.53
Grant County Total	40.21	41.46	43.04	49.67
Inside Kentucky River Basin	47.29	49.14	51.18	59.34
Urban	-	-	-	-
Rural	47.29	49.14	51.18	59.34
Harlan County Total	79.83	78.53	77.08	70.80
Inside Kentucky River Basin	80.04	78.57	77.08	70.84
Urban	-	-	-	-
Rural	80.04	78.57	77.08	70.84
Henry County Total	37.74	39.50	41.74	51.34
Inside Kentucky River Basin	27.32	28.39	29.91	37.18
Urban	-	-	-	-
Rural	27.32	28.39	29.91	37.18
Jackson County Total	29.69	31.21	33.20	41.21
Inside Kentucky River Basin	29.33	31.20	33.19	41.20
Urban	-	-	-	-
Rural	29.33	31.20	33.19	41.20
Jessamine County Total	98.47	110.41	124.29	179.24
Inside Kentucky River Basin	98.47	110.41	124.29	179.24
Urban	2,950.79	2,957.97	2,964.02	2,964.71
Rural	46.79	45.41	43.10	26.87
Knott County Total	41.28	41.09	41.81	42.59
Inside Kentucky River Basin	41.07	41.40	42.77	46.55
Urban	-	-	-	-
Rural	41.07	41.40	42.77	46.55
Knox County Total	63.68	64.22	64.85	65.72
Inside Kentucky River Basin	62.87	63.51	64.14	64.98
Urban	-	-	-	-
Rural	62.87	63.51	64.14	64.98
Lee County Total	31.37	30.75	30.37	28.95
Inside Kentucky River Basin	31.37	30.75	30.37	28.95
Urban	-	-	-	-
Rural	31.37	30.75	30.37	28.95
Leslie County Total	28.21	29.17	29.96	31.92
Inside Kentucky River Basin	28.21	29.17	29.96	31.92
Urban	-	-	-	-
Rural	28.21	29.17	29.96	31.92
Letcher County Total	68.33	66.21	63.79	57.48
Inside Kentucky River Basin	72.39	70.05	67.81	57.86
Urban	-	-	-	-
Rural	72.39	70.05	67.81	57.86
Lincoln County Total	49.01	50.21	52.81	57.55
Inside Kentucky River Basin	57.03	58.72	61.62	67.76
Urban	841.49	841.50	841.19	841.08
Rural	45.27	46.50	48.96	53.11
Madison County Total	95.89	103.72	112.47	142.46
Inside Kentucky River Basin	95.89	103.72	112.47	142.46
Urban	3,466.81	3,468.54	3,470.03	3,471.70
Rural	43.11	43.61	43.97	43.21
Menifee County Total	19.28	19.38	19.44	19.68
Inside Kentucky River Basin	17.03	17.09	17.20	17.20
Urban	-	-	-	-
Rural	17.03	17.09	17.20	17.20

Exhibit A-2.2t - County and Sub-Area Population Density (1970 - 1995)

Area Breakdown	Persons Per Square Mile			
	1970	1975	1980	1995
Mercer County Total	61.62	65.44	69.84	86.98
Inside Kentucky River Basin	39.91	43.09	46.48	59.11
Urban	-	-	-	-
Rural	39.91	43.09	46.48	59.11
Montgomery County Total	75.31	81.93	89.61	119.40
Inside Kentucky River Basin	50.71	57.37	65.10	94.98
Urban	-	-	-	-
Rural	50.71	57.37	65.10	94.98
Owen County Total	21.28	21.25	21.55	22.74
Inside Kentucky River Basin	21.28	21.25	21.55	22.74
Urban	-	-	-	-
Rural	21.28	21.25	21.55	22.74
Owsley County Total	25.50	25.10	25.38	26.20
Inside Kentucky River Basin	25.50	25.10	25.38	26.20
Urban	-	-	-	-
Rural	25.50	25.10	25.38	26.20
Perry County Total	76.56	73.29	71.26	62.04
Inside Kentucky River Basin	76.56	73.29	71.26	62.04
Urban	2,293.70	2,293.70	2,293.70	2,293.70
Rural	61.06	57.78	55.73	46.45
Powell County Total	44.53	47.62	51.15	63.54
Inside Kentucky River Basin	44.53	47.62	51.15	63.54
Urban	-	-	-	-
Rural	44.53	47.62	51.15	63.54
Rockcastle County Total	39.56	41.50	43.83	52.60
Inside Kentucky River Basin	30.78	41.51	43.86	52.62
Urban	-	-	-	-
Rural	30.78	41.51	43.86	51.62
Scott County Total	63.20	66.02	69.04	79.03
Inside Kentucky River Basin	63.20	66.02	69.04	79.03
Urban	4,664.32	4,678.79	4,691.94	4,697.25
Rural	33.03	32.85	34.44	37.18
Shelby County Total	49.47	51.80	54.62	65.67
Inside Kentucky River Basin	36.98	41.61	43.91	53.48
Urban	-	-	-	-
Rural	36.98	41.61	43.91	53.48
Trimble County Total	36.63	37.58	38.61	41.11
Inside Kentucky River Basin	47.96	49.76	51.64	57.34
Urban	-	-	-	-
Rural	47.96	49.76	51.64	57.34
Wolfe County Total	24.97	24.73	24.95	25.67
Inside Kentucky River Basin	24.97	24.73	24.95	25.67
Urban	-	-	-	-
Rural	24.97	24.73	24.95	25.67
Woodford County Total	74.79	81.10	88.38	116.21
Inside Kentucky River Basin	74.79	81.10	88.38	116.21
Urban	3,380.36	3,381.40	3,388.51	3,395.69
Rural	45.76	46.72	47.70	55.99

HOUSING DISAGGREGATION

DISAGGREGATION OF HOUSING TRENDS AND PROJECTIONS

Introduction

Population projections produced in Appendix 2 were translated into housing units in Appendix 3. The average number of persons per housing unit in 1970 in each county within the Kentucky River Basin was obtained from 1970 U.S. Bureau of Census figures. For 1975 and 1980, persons per housing unit factors developed for the Kentucky Housing Corporation and published in Housing Needs Analysis: Commonwealth of Kentucky were utilized. Together the 1970, 1975 and 1980 figures were used to project 1995 figures, with 2.60 persons per dwelling unit maintained as the maximum lower limit.

EXHIBIT A-3.1t presents the average population per dwelling unit for each county within the Kentucky River Basin for the years 1970, 1975, 1980 and 1995.

EXHIBIT A-3.2t presents housing unit trends and projections for each of the thirty-nine counties within the Kentucky River Basin. The "in basin" figures are further disaggregated into urban, rural, farm and non-farm categories with individual segment data presented in Appendix B.

Exhibit A-3.1t - Population Per Housing Unit for the Kentucky River Basin Counties

Kentucky River Basin Counties	Population Per Housing Unit			
	1970	1975	1980	1995
Anderson County	3.10	3.05	2.99	2.84
Bell County	3.32	3.13	2.90	2.60
Boone County	3.53	3.49	3.44	3.32
Bourbon County	3.10	3.00	2.90	2.60
Boyle County	3.09	2.92	2.74	2.60
Breathitt County	3.74	3.53	3.29	2.60
Carroll County	3.09	3.03	2.96	2.78
Casey County	3.18	2.99	2.78	2.60
Clark County	3.15	3.07	2.99	2.75
Clay County	3.86	3.64	3.40	2.80
Estill County	3.25	3.16	3.04	2.68
Fayette County	3.19	3.11	3.01	2.74
Franklin County	3.12	3.04	2.95	2.71
Gallatin County	3.15	3.12	3.07	2.95
Garrard County	2.97	2.87	2.76	2.60
Grant County	3.05	2.98	2.90	2.70
Harlan County	3.34	3.13	2.91	2.60
Henry County	3.00	2.92	2.82	2.55
Jackson County	3.35	3.16	2.96	2.60
Jessamine County	3.32	3.21	3.09	2.76

Kentucky River Basin Counties	Population Per Housing Unit			
	1970	1975	1980	1995
Knott County	3.80	3.56	3.30	2.60
Knox County	3.33	3.19	2.98	2.60
Lee County	3.27	3.10	2.91	2.60
Leslie County	3.91	3.63	3.33	2.60
Letcher County	3.40	3.17	2.92	2.68
Lincoln County	3.19	3.06	2.91	2.60
Madison County	3.58	3.58	3.58	3.40
Menifee County	3.42	3.31	3.19	2.86
Mercer County	2.99	2.92	2.85	2.64
Montgomery County	3.16	3.08	2.99	2.75
Owen County	2.91	2.81	2.70	2.60
Owsley County	3.44	3.31	3.17	2.78
Perry County	3.61	3.38	3.14	2.60
Powell County	3.47	3.34	3.20	2.81
Rockcastle County	3.38	3.26	3.13	2.77
Scott County	3.31	3.27	3.22	3.07
Shelby County	3.19	3.11	3.03	2.79
Trimble County	3.15	3.03	2.84	2.60
Wolfe County	3.44	3.23	2.99	2.60
Woodford County	3.31	3.26	3.20	3.05

Exhibit A-3.2t Housing Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Occupied Housing Units				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Thirty-Nine County Total	238,928	261,336	286,568	382,852	8.6	8.8	25.1
Out of Basin	76,493	82,751	90,064	116,864	7.5	8.1	22.9
In Kentucky River Basin	162,435	178,585	196,504	265,988	9.0	9.1	26.1
Urban	80,638	93,165	105,497	161,648	13.4	11.7	34.7
Rural	81,797	85,420	90,907	104,340	4.2	6.0	12.8
Farm	73,857	76,563	80,989	91,421	3.5	5.5	11.4
Non-Farm	7,940	8,857	9,918	12,919	10.3	10.7	23.2
Anderson County	3,015	3,212	3,443	4,273	6.1	6.7	19.4
Out of Basin	2,741	2,817	3,003	3,750	2.7	6.2	19.9
In Kentucky River Basin	274	395	440	523	30.6	10.2	15.8
Urban	-	-	-	-	-	-	-
Rural	274	395	440	523	30.6	10.2	15.8
Farm	274	395	440	523	30.6	10.2	15.8
Non-Farm	-	-	-	-	-	-	-
Bell County	9,338	10,000	10,886	12,281	6.6	8.1	11.3
Out of Basin	9,002	9,640	10,494	11,840	6.6	8.1	11.3
In Kentucky River Basin	336	360	392	441	6.6	8.1	11.3
Urban	-	-	-	-	-	-	-
Rural	336	360	392	441	6.6	8.1	11.3
Farm	336	360	392	441	6.6	8.1	11.3
Non-Farm	-	-	-	-	-	-	-
Boone County	9,282	10,903	12,947	21,781	14.8	15.7	40.5
Out of Basin	9,036	10,652	12,684	21,522	15.1	16.0	41.1
In Kentucky River Basin	242	251	263	259	3.6	4.5	1.5
Urban	-	-	-	-	-	-	-
Rural	242	251	263	259	3.6	4.5	1.5
Farm	242	251	263	259	3.6	4.5	1.5
Non-Farm	-	-	-	-	-	-	-
Boyle County	6,820	7,334	7,944	8,753	9.2	7.6	9.2
Out of Basin	1,750	1,703	1,850	1,996	2.7	7.9	7.3
In Kentucky River Basin	5,070	5,631	6,094	6,757	9.9	7.6	9.8
Urban	3,732	4,065	4,562	5,673	8.2	10.8	19.6
Rural	1,338	1,566	1,532	1,084	14.5	2.2	29.2
Farm	999	1,203	1,139	623	16.9	5.3	45.3
Non-Farm	339	363	393	461	6.6	7.6	14.7
Breathitt County	3,802	4,081	4,507	6,186	6.8	9.4	27.1
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	3,802	4,081	4,507	6,186	6.8	9.4	27.1
Urban	-	-	-	-	-	-	-
Rural	3,802	4,081	4,507	6,186	6.8	9.4	27.1
Farm	3,297	3,545	3,930	5,428	6.9	9.7	27.6
Non-Farm	505	536	577	758	5.7	7.1	31.3
Carroll County	2,755	2,924	3,128	3,903	5.8	6.5	19.8
Out of Basin	533	566	616	618	5.8	8.1	0.3
In Kentucky River Basin	2,222	2,358	2,512	3,285	5.7	6.1	23.6
Urban	1,256	1,317	1,385	2,160	4.6	4.9	35.9
Rural	966	1,041	1,127	1,125	7.2	7.6	0.2
Farm	716	768	831	764	6.7	7.6	8.7
Non-Farm	252	273	296	361	7.6	7.7	18.0
Casey County	4,059	4,274	4,548	4,611	5.0	6.0	1.4
Out of Basin	4,029	4,243	4,515	4,579	5.0	6.0	1.4
In Kentucky River Basin	30	31	33	32	3.2	6.0	3.1
Urban	-	-	-	-	-	-	-
Rural	30	31	33	32	3.2	6.0	3.1
Farm	30	31	33	32	3.2	6.0	3.1
Non Farm	-	-	-	-	-	-	-
Clark County	7,645	8,457	9,415	13,170	9.6	10.1	28.5
Out of Basin	5,676	6,348	7,154	9,988	10.6	11.3	28.4
In Kentucky River Basin	1,969	2,109	2,261	3,182	6.6	6.7	28.9
Urban	-	-	-	-	-	-	-
Rural	1,969	2,109	2,261	3,182	6.6	6.7	28.9
Farm	1,969	2,109	2,261	3,182	6.6	6.7	28.9
Non-Farm	-	-	-	-	-	-	-

Exhibit A-3.2t Housing Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Occupied Housing Units				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Clay County	4,787	4,943	5,129	5,395	3.2	3.6	4.9
Out of Basin	218	262	262	275	16.2	0	4.7
In Kentucky River Basin	4,569	4,681	4,867	5,120	2.4	3.8	4.9
Urban	-	-	-	-	-	-	-
Rural	4,569	4,681	4,867	5,120	2.4	3.8	4.9
Farm	4,138	4,189	4,302	4,389	1.2	2.6	2.0
Non-Farm	431	492	565	731	12.4	12.9	22.7
Estill County	3,922	4,195	5,389	6,113	6.5	22.1	13.4
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	3,922	4,195	5,389	6,113	6.5	22.1	13.4
Urban	1,139	1,262	1,817	2,061	9.7	30.5	11.8
Rural	2,783	2,933	3,572	4,052	5.1	21.8	11.8
Farm	2,783	2,933	3,572	4,052	5.1	21.8	11.8
Non-Farm	-	-	-	-	-	-	-
Fayette County	54,492	62,065	68,923	106,422	12.2	9.9	35.2
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	54,492	62,065	68,923	106,422	12.2	9.9	35.2
Urban	50,550	58,962	65,477	101,101	14.3	9.9	35.2
Rural	3,942	3,103	3,446	5,321	21.3	9.9	35.2
Farm	3,942	3,103	3,446	5,321	21.3	9.9	35.2
Non-Farm	-	-	-	-	-	-	-
Franklin County	11,051	12,146	13,440	18,033	9.1	9.6	25.4
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	11,051	12,146	13,440	18,033	9.1	9.6	25.4
Urban	6,845	7,798	9,358	14,836	13.3	15.6	36.9
Rural	4,206	4,348	4,082	3,197	1.5	6.5	27.7
Farm	4,206	4,348	4,082	3,197	1.5	6.5	27.7
Non-Farm	-	-	-	-	-	-	-
Gallatin County	1,309	1,439	1,606	2,300	9.0	10.4	30.2
Out of Basin	1,063	1,157	1,225	1,856	8.1	5.5	34.0
In Kentucky River Basin	246	282	381	444	12.7	26.0	14.2
Urban	-	-	-	-	-	-	-
Rural	246	282	381	444	12.7	26.0	14.2
Farm	195	228	326	389	14.5	30.0	16.2
Non-Farm	51	54	55	55	5.5	1.8	0
Garrard County	3,174	3,345	3,565	4,106	5.1	6.2	13.2
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	3,174	3,345	3,565	4,106	5.1	6.2	13.2
Urban	1,087	1,193	1,324	1,711	8.8	9.9	22.6
Rural	2,087	2,152	2,241	2,395	3.0	4.0	6.4
Farm	2,087	2,152	2,241	2,395	3.0	4.0	6.4
Non-Farm	-	-	-	-	-	-	-
Grant County	3,269	3,460	3,691	4,575	5.5	6.2	19.3
Out of Basin	651	668	703	854	2.5	5.0	17.7
In Kentucky River Basin	2,618	2,792	2,988	3,721	6.2	6.5	19.7
Urban	-	-	-	-	-	-	-
Rural	2,618	2,792	2,988	3,721	6.2	6.5	19.7
Farm	1,389	1,449	1,524	1,837	4.1	4.9	17.0
Non-Farm	1,229	1,343	1,464	1,884	8.5	8.3	22.3
Harlan County	11,165	11,744	11,498	12,746	4.9	2.1	9.8
Out of Basin	9,960	10,463	10,147	11,357	4.8	3.1	10.6
In Kentucky River Basin	1,205	1,281	1,351	1,389	5.9	5.2	2.7
Urban	-	-	-	-	-	-	-
Rural	1,205	1,281	1,351	1,389	5.9	5.2	2.7
Farm	1,205	1,281	1,351	1,389	5.9	5.2	2.7
Non-Farm	-	-	-	-	-	-	-
Henry County	3,626	3,911	4,278	5,818	7.3	8.6	26.5
Out of Basin	1,223	1,334	1,467	1,956	8.3	9.1	25.0
In Kentucky River Basin	2,403	2,577	2,811	3,862	6.7	8.3	26.3
Urban	-	-	-	-	-	-	-
Rural	2,403	2,577	2,811	3,862	6.7	8.3	26.3
Farm	2,039	2,040	2,241	3,171	0	8.9	29.3
Non-Farm	364	537	570	691	32.2	5.8	17.5

Exhibit A-3.2t Housing Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Occupied Housing Units				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Jackson County	2,980	3,328	3,780	5,341	10.4	11.9	29.2
Out of Basin	1,670	1,841	2,097	2,965	9.6	11.9	29.3
In Kentucky River Basin	1,310	1,481	1,683	2,376	11.5	12.0	29.2
Urban	-	-	-	-	-	-	-
Rural	1,310	1,481	1,683	2,376	11.5	12.0	29.2
Farm	1,310	1,481	1,683	2,376	11.5	12.0	29.2
Non-Farm	-	-	-	-	-	-	-
Jessamine County	5,250	6,088	7,119	11,494	13.7	14.5	38.0
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	5,250	6,088	7,119	11,494	13.7	14.5	38.0
Urban	2,799	3,640	4,719	9,861	23.1	22.8	52.1
Rural	2,451	2,448	2,400	1,633	0.1	2.0	46.9
Farm	2,451	2,448	2,400	1,633	0.1	2.0	46.9
Non-Farm	-	-	-	-	-	-	-
Knott County	3,858	4,108	4,494	5,831	6.1	8.6	22.9
Out of Basin	1,076	1,108	1,150	1,213	2.9	5.6	5.2
In Kentucky River Basin	2,782	3,000	3,344	4,618	7.3	10.3	27.6
Urban	-	-	-	-	-	-	-
Rural	2,782	3,000	3,344	4,618	7.3	10.3	27.6
Farm	2,569	2,746	3,041	4,147	6.4	9.7	26.7
Non-Farm	213	254	303	471	16.1	16.2	35.7
Knox County	6,985	7,488	8,095	9,403	6.7	7.5	13.9
Out of Basin	6,309	6,762	7,309	8,491	6.7	7.5	13.9
In Kentucky River Basin	676	726	786	912	6.9	7.6	13.8
Urban	-	-	-	-	-	-	-
Rural	676	726	786	912	6.9	7.6	13.8
Farm	676	726	786	912	6.9	7.6	13.8
Non-Farm	-	-	-	-	-	-	-
Lee County	2,008	2,083	2,191	2,338	3.6	4.9	6.3
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	2,008	2,083	2,191	2,338	3.6	4.9	6.3
Urban	-	-	-	-	-	-	-
Rural	2,008	2,083	2,191	2,338	3.6	4.9	6.3
Farm	1,727	1,785	1,874	1,983	3.2	4.7	5.5
Non-Farm	281	298	317	355	5.7	6.0	10.7
Leslie County	2,972	3,295	3,706	5,058	9.8	11.1	26.7
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	2,972	3,295	3,706	5,058	9.8	11.1	26.7
Urban	-	-	-	-	-	-	-
Rural	2,972	3,295	3,706	5,058	9.8	11.1	26.7
Farm	2,849	3,141	3,516	4,642	9.3	10.6	24.2
Non-Farm	123	154	190	416	20.1	18.9	54.3
Letcher County	6,807	7,080	7,476	7,271	3.8	5.3	2.8
Out of Basin	1,008	1,056	1,146	1,386	4.5	7.8	17.3
In Kentucky River Basin	5,799	6,024	6,330	5,885	3.7	4.8	7.5
Urban	-	-	-	-	-	-	-
Rural	5,799	6,024	6,330	5,885	3.7	4.8	7.5
Farm	4,813	4,967	5,182	4,634	3.1	4.1	11.8
Non-Farm	986	1,057	1,148	1,251	6.7	7.9	8.2
Lincoln County	5,220	5,579	6,169	7,525	6.4	9.5	18.0
Out of Basin	1,664	1,760	1,956	2,339	5.4	10.0	16.4
In Kentucky River Basin	3,556	3,819	4,213	5,186	6.9	9.4	18.7
Urban	776	841	919	1,196	7.7	8.5	23.1
Rural	2,780	2,978	3,294	3,990	6.6	9.6	17.4
Farm	2,381	2,549	2,830	3,418	6.6	9.9	17.2
Non-Farm	399	429	464	572	7.0	7.5	18.9
Madison County	11,936	12,909	13,999	18,670	7.5	7.8	25.0
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	11,936	12,909	13,999	18,670	7.5	7.8	25.0
Urban	6,653	7,576	8,636	13,172	12.2	12.3	34.4
Rural	5,283	5,333	5,363	5,498	0.9	0.5	2.4
Farm	5,283	5,333	5,363	5,498	0.9	0.5	2.4
Non-Farm	-	-	-	-	-	-	-

Exhibit A-3.2t Housing Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Occupied Housing Units				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Menifee County	1,181	1,229	1,279	1,444	3.9	3.9	11.4
Out of Basin	791	824	856	972	4.0	3.7	11.9
In Kentucky River Basin	390	405	423	472	3.7	4.2	10.4
Urban	-	-	-	-	-	-	-
Rural	390	405	423	472	3.7	4.2	10.4
Farm	390	405	423	472	3.7	4.2	10.4
Non-Farm	-	-	-	-	-	-	-
Mercer County	5,332	5,804	6,347	8,533	8.1	8.5	25.6
Out of Basin	4,132	4,476	4,879	6,518	7.7	8.2	25.1
In Kentucky River Basin	1,200	1,328	1,468	2,015	9.6	9.5	27.1
Urban	-	-	-	-	-	-	-
Rural	1,200	1,328	1,468	2,015	9.6	9.5	27.1
Farm	865	967	1,081	1,541	10.5	10.5	29.8
Non-Farm	335	361	387	474	7.2	6.7	18.3
Montgomery County	4,849	5,426	6,114	8,857	10.6	11.2	30.9
Out of Basin	4,441	4,951	5,558	7,976	10.3	10.9	30.3
In Kentucky River Basin	408	475	556	881	14.1	14.5	36.9
Urban	-	-	-	-	-	-	-
Rural	408	475	556	881	14.1	14.5	36.9
Farm	408	475	556	881	14.1	14.5	36.9
Non-Farm	-	-	-	-	-	-	-
Owen County	2,563	2,654	2,801	3,070	3.4	5.2	8.7
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	2,563	2,654	2,801	3,070	3.4	5.2	8.7
Urban	-	-	-	-	-	-	-
Rural	2,563	2,654	2,801	3,070	3.4	5.2	8.7
Farm	2,017	2,077	2,188	2,395	2.9	5.1	8.6
Non-Farm	546	577	613	675	5.4	5.9	9.2
Owsley County	1,459	1,493	1,576	1,856	2.3	5.2	15.1
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	1,459	1,493	1,576	1,856	2.3	5.2	15.1
Urban	-	-	-	-	-	-	-
Rural	1,459	1,493	1,576	1,856	2.3	5.2	15.1
Farm	1,423	1,455	1,537	1,811	2.2	5.3	15.1
Non-Farm	36	38	39	45	5.2	2.5	13.3
Perry County	7,122	7,437	7,783	8,184	4.2	4.4	4.9
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	7,122	7,437	7,783	8,184	4.2	4.4	4.9
Urban	1,481	1,615	1,738	2,099	8.3	7.1	17.2
Rural	5,641	5,822	6,045	6,085	3.1	3.7	0.6
Farm	5,539	5,711	5,925	5,940	3.0	3.6	0.2
Non-Farm	102	111	120	145	8.1	7.5	17.2
Powell County	2,215	2,466	2,765	3,911	10.2	10.8	29.3
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	2,215	2,466	2,765	3,911	10.2	10.8	29.3
Urban	-	-	-	-	-	-	-
Rural	2,215	2,466	2,765	3,911	10.2	10.8	29.3
Farm	1,347	1,438	1,393	1,757	6.3	3.2	20.7
Non-Farm	868	1,028	1,372	2,154	15.5	25.1	36.3
Rockcastle County	3,615	3,958	4,354	5,906	8.6	9.1	26.3
Out of Basin	3,284	3,487	3,836	5,203	5.8	9.1	26.3
In Kentucky River Basin	331	471	518	703	29.7	9.1	26.3
Urban	-	-	-	-	-	-	-
Rural	331	471	518	703	29.7	9.1	26.3
Farm	331	471	518	703	29.7	9.1	26.3
Non-Farm	-	-	-	-	-	-	-
Scott County	5,417	5,733	6,089	7,310	5.5	5.8	16.7
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	5,417	5,733	6,089	7,310	5.5	5.8	16.7
Urban	2,604	2,833	3,074	3,901	8.1	7.8	21.2
Rural	2,813	2,900	3,015	3,409	3.0	3.8	11.5
Farm	2,688	2,767	2,872	3,148	2.8	3.6	8.7
Non-Farm	125	133	143	261	6.0	7.0	45.2

Exhibit A-3.2t Housing Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Occupied Housing Units				Between Year Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Shelby County	5,953	6,396	6,921	9,037	6.9	7.6	23.4
Out of Basin	5,255	5,589	6,047	7,882	6.0	7.5	23.3
In Kentucky River Basin	698	807	874	1,155	13.5	7.6	24.3
Urban	-	-	-	-	-	-	-
Rural	698	807	874	1,155	13.5	7.6	24.3
Farm	698	807	874	1,155	13.5	7.6	24.3
Non-Farm	-	-	-	-	-	-	-
Trimble County	1,695	1,810	1,950	2,364	6.3	7.1	17.5
Out of Basin	981	1,038	1,110	1,328	5.5	6.5	16.4
In Kentucky River Basin	714	772	840	1,036	7.5	8.1	18.9
Urban	-	-	-	-	-	-	-
Rural	714	772	840	1,036	7.5	8.1	18.9
Farm	467	494	528	632	5.4	6.4	16.4
Non-Farm	247	278	312	404	11.2	10.8	22.7
Wolfe County	1,643	1,738	1,893	2,241	5.4	8.2	15.5
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	1,643	1,738	1,893	2,241	5.4	8.2	15.5
Urban	-	-	-	-	-	-	-
Rural	1,643	1,738	1,893	2,241	5.4	8.2	15.5
Farm	1,522	1,608	1,741	2,019	5.3	7.6	13.7
Non-Farm	121	130	152	222	6.9	14.4	31.5
Woodford County	4,361	4,801	5,330	7,353	9.1	9.9	27.5
Out of Basin	-	-	-	-	-	-	-
In Kentucky River Basin	4,361	4,801	5,330	7,353	9.1	9.9	27.5
Urban	1,716	2,068	2,488	3,874	16.8	17.1	35.8
Rural	2,645	2,738	2,842	3,479	3.4	3.6	18.3
Farm	2,259	2,327	2,404	2,946	2.9	3.2	18.4
Non-Farm	386	411	438	533	6.1	6.1	17.8

EMPLOYMENT DISAGGREGATION

EMPLOYMENT DISAGGREGATION

Introduction

Methodologies for developing non-agricultural wage and salary employment projections for counties within the Kentucky River Basin is outlined in Appendix 5. County employment projections were then disaggregated between "in basin" and "out of basin" according to the following procedure. All or the major share of employment within each county was allocated to that river basin which contained the urban and rural non-farm communities, where most employment is concentrated. When a county's urban and rural non-farm communities were located in more than one river basin, the "in basin" and "out of basin" split was calculated based upon population/ employment ratios.

In 1970 there was a total of 213,175 non-agricultural wage and salary workers in the thirty-nine counties which comprise the Kentucky River Basin. Of this total, an estimated 153,026 jobs were located within the Kentucky River Basin. By 1995, it is estimated that the number of non-agricultural wage and salary jobs in the Kentucky River Basin will more than double, to a total of some 310,119. The major share of these jobs will be located within the Bluegrass Region in the urban centers of Lexington, Frankfort, Georgetown, Winchester, Versailles, Nicholasville, Richmond and Berea.

Exhibit A-4.1t Employment Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Employment				Between Year Number/Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Thirty-Nine County Total	213,175	274,951	334,496	440,547	61,776/28.9	59,545/21.6	106,051/31.7
Out of Basin	60,149	77,040	98,160	130,428	16,891/28.1	21,120/27.4	32,268/32.8
In Ky. River Basin	153,026	197,911	236,336	310,119	44,885/29.3	38.425/19.4	73,783/31.2
Anderson County	2,076	2,709	3,300	4,204	633/30.5	500/18.4	904/27.3
Out of Basin	1,747	2,376	2,878	3,629	629/36.0	751/26.1	751/20.6
In Ky. River Basin	329	333	422	575	4/ 1.2	89/26.7	153/36.2
Bell County	7,303	9,048	10,802	13,930	1,745/23.8	1,754/19.3	3,128/28.9
Out of Basin	7,303	9,048	10,802	13,930	1,745/23.8	1,754/19.3	3,128/28.9
In Ky. River Basin	-	-	-	-	-	-	-
Boone County	8,680	15,000	21,700	32,800	6,320/72.8	6,700/44.6	11,100/51.1
Out of Basin	8,680	15,000	21,700	32,800	6,320/72.8	6,700/44.6	11,100/51.1
In Kentucky River Basin	-	-	-	-	-	-	-
Boyle County	7,944	10,161	12,413	15,904	2,217/27.9	2,252/18.1	3,491/21.9
Out of Basin	1,600	2,360	2,891	3,626	760/32.2	531/18.4	735/20.3
In Ky. River Basin	6,344	7,801	9,522	12,278	1,457/22.9	1,721/22.0	2,756/28.9
Breathitt County	2,342	2,953	3,557	4,848	611/26.1	604/20.4	1,291/36.3
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	2,342	2,953	3,557	4,848	611/26.1	604/20.4	1,291/36.3
Carroll County	3,263	3,404	3,546	4,154	141/ 4.1	142/ 4.0	608/17
Out of Basin	632	659	698	658	27/ 4.1	39/ 5.5	-40/-6.0
In Ky. River Basin	2,631	2,745	2,848	3,496	114/ 4.1	103/ 3.6	648/22.7
Casey County	1,827	2,323	2,834	3,595	496/27.1	511/21.9	761/26.8
Out of Basin	1,827	2,323	2,834	3,595	496/27.1	511/21.9	761/26.8
In Ky. River Basin	-	-	-	-	-	-	-
Clark County	7,999	10,278	13,501	18,669	2,279/28.5	3,223/31.3	5,168/38.2
Out of Basin	5,333	6,852	9,001	12,446	1,519/28.4	2,149/31.3	3,445/38.2
In Ky. River Basin	2,666	3,426	4,500	6,223	760/28.5	1,074/31.3	1,723/38.2
Clay County	2,439	3,016	3,601	4,643	577/23.6	585/19.4	1,042/28.9
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	2,439	3,016	3,601	4,643	577/23.6	585/19.4	1,042/28.9

Exhibit A-4.1t Employment Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Employment				Between Year Number/Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Estill County	1,460	1,826	2,200	2,809	366/25.0	374/20.5	609/27.7
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	1,460	1,826	2,200	2,809	366/25.0	374/20.5	609/27.7
Fayette County	76,808	97,955	112,750	140,323	21,147/27.5	14,795/15.1	27,573/24.4
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	76,808	97,955	112,750	140,323	21,147/27.5	14,795/15.1	27,573/24.4
Franklin County	13,730	17,425	22,601	30,111	3,695/26.9	5,176/29.7	7,510/33.2
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	13,730	17,425	22,601	30,111	3,695/26.9	5,176/29.7	7,510/33.2
Gallatin County	421	462	502	690	41/ 9.7	40/ 8.6	188/37.4
Out of Basin	338	371	383	574	33/ 9.7	12/ 3.2	191/49.8
In Ky. River Basin	83	91	119	116	8/ 9.6	28/30.0	-3/-2.5
Garrard County	1,635	2,074	2,521	3,156	439/26.8	447/21.5	635/25.1
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	1,635	2,074	2,521	3,156	439/26.8	447/21.5	635/25.1
Grant County	1,555	1,803	2,095	2,436	248/15.9	292/16.2	341/16.2
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	1,555	1,803	2,095	2,436	248/15.9	292/16.2	341/16.2
Harlan County	7,665	9,521	11,368	14,660	1,856/24.2	1,847/19.4	3,292/28.9
Out of Basin	7,665	9,521	11,368	14,660	1,856/24.2	1,847/19.4	3,292/28.9
In Ky. River Basin	-	-	-	-	-	-	-
Henry County	1,790	3,115	4,510	5,545	1,325/74.0	1,395/44.8	1,035/22.9
Out of Basin	1,193	2,077	3,007	3,697	884/74.1	930/44.8	690/22.9
In Ky. River Basin	597	1,038	1,503	1,848	441/73.9	465/44.8	345/22.9
Jackson County	1,212	1,508	1,800	2,322	296/24.4	292/19.3	522/29.0
Out of Basin	1,212	1,508	1,800	2,322	296/24.4	292/19.3	522/29.0
In Ky. River Basin	-	-	-	-	-	-	-
Jessamine County	2,362	2,976	4,888	7,227	614/25.9	1,912/64.2	2,339/47.8
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	2,362	2,976	4,888	7,227	614/25.9	1,912/64.2	2,339/47.8
Knott County	1,646	2,052	2,458	3,244	406/24.6	406/19.7	786/31.9
Out of Basin	461	575	689	909	114/24.7	114/19.8	220/31.9
In Ky. River Basin	1,185	1,477	1,769	2,335	292/24.6	292/19.8	566/31.9
Knox County	3,860	4,782	5,710	7,363	922/23.8	928/19.4	1,653/28.9
Out of Basin	3,860	4,782	5,710	7,363	922/23.8	928/19.4	1,653/28.9
In Ky. River Basin	-	-	-	-	-	-	-
Lee County	1,031	1,208	1,410	1,785	177/17.2	202/16.7	375/26.6
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	1,031	1,208	1,410	1,785	177/17.2	202/16.7	375/26.6
Leslie County	1,334	1,662	2,001	2,688	328/19.7	339/16.9	687/25.5
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	1,334	1,662	2,001	2,688	328/19.7	339/16.9	687/25.5
Letcher County	5,294	6,561	7,827	10,940	1,267/23.9	1,266/19.3	3,113/39.7
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	5,294	6,561	7,827	10,940	1,267/23.9	1,266/19.3	3,113/39.7
Lincoln County	2,109	2,683	3,264	4,156	754/35.7	581/21.6	892/27.3
Out of Basin	675	859	1,045	1,330	184/27.2	186/21.6	285/27.3
In Ky. River Basin	1,434	1,824	2,219	2,826	390/27.2	395/21.6	607/27.3
Madison County	11,995	15,267	20,040	27,100	3,272/27.3	4,773/31.3	7,060/26.0
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	11,995	15,267	20,040	27,100	3,272/27.3	4,773/31.3	7,060/26.0

Exhibit A-4.1t Employment Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year Actual or Projected Employment				Between Year Number/Percentage Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Menifee County	322	424	527	686	102/24.0	103/24.3	159/30.1
Out of Basin	322	424	527	686	102/24.0	103/24.3	159/30.1
In Ky. River Basin	-	-	-	-	-	-	-
Mercer County	3,859	4,897	5,970	7,609	1,038/26.9	1,073/17.9	1,639/21.5
Out of Basin	3,063	3,777	4,589	5,812	714/18.9	812/17.7	1,223/21.0
In Ky. River Basin	796	1,120	1,381	1,897	324/28.9	261/18.9	516/27.2
Montgomery County	5,068	6,703	8,346	10,830	1,635/32.2	1,643/24.5	2,484/29.7
Out of Basin	5,068	6,703	8,346	10,830	1,635/32.2	1,643/24.5	2,484/29.7
In Ky. River Basin	-	-	-	-	-	-	-
Owen County	978	1,179	1,370	1,704	201/20.5	191/16.2	334/24.3
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	978	1,179	1,370	1,704	201/20.5	191/16.2	334/24.3
Owsley County	462	579	697	922	117/25.3	118/20.4	225/32.3
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	462	579	697	922	117/25.3	118/20.4	225/32.3
Perry County	6,534	8,218	9,891	13,545	1,684/25.7	1,673/20.3	3,654/36.9
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	6,534	8,218	9,891	13,545	1,684/25.7	1,673/20.3	3,654/36.9
Powell County	1,119	1,371	1,647	2,092	252/22.5	276/20.1	445/27.0
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	1,119	1,371	1,647	2,092	252/22.5	276/20.1	445/27.0
Rockcastle County	1,237	1,552	1,853	2,389	315/25.4	301/19.4	536/28.9
Out of Basin	1,237	1,552	1,853	2,389	315/25.4	301/19.4	536/28.9
In Ky. River Basin	-	-	-	-	-	-	-
Scott County	3,509	4,527	5,586	7,829	1,018/29.0	1,059/23.4	2,243/40.1
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	3,509	4,527	5,586	7,829	1,018/29.0	1,059/23.4	2,243/40.1
Shelby County	4,500	6,350	8,200	9,373	1,850/41.1	1,850/29.1	1,173/14.3
Out of Basin	4,275	6,032	7,790	8,904	1,757/41.1	1,758/29.1	1,114/14.3
In Ky. River Basin	225	318	410	469	93/41.3	92/28.9	59/14.3
Trimble County	415	426	437	477	11/ 2.6	11/ 2.6	40/ 9.1
Out of Basin	238	244	249	268	6/ 2.5	5/ 2.0	19/ 7.6
In Ky. River Basin	177	182	188	209	5/ 2.8	6/ 3.3	21/11.1
Wolfe County	632	770	898	1,144	138/21.8	128/16.6	246/27.3
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	632	770	898	1,144	138/21.8	128/16.6	246/27.3
Woodford County	4,760	6,183	8,845	12,645	1,423/29.8	2,662/43.0	3,800/42.9
Out of Basin	-	-	-	-	-	-	-
In Ky. River Basin	4,760	6,183	8,845	12,645	1,423/29.8	2,662/43.0	3,800/42.9

ADD EMPLOYMENT DISAGGREGATION

Introduction

Information on existing and projected employment is useful in assessing the impacts of wastewater discharges from industries and other employers on water quality within a river basin. Therefore, it was necessary to develop employment projections for 1975, 1980 and 1995.

For control purposes, it was decided that employment projections developed by the Kentucky Department of Commerce would be utilized. The Commerce projections covered the entire state and the ADDs for 1980 and 1990, but did not include subdivisions of the manufacturing category. Therefore, it was necessary to insert the missing manufacturing subdivisions, interpolate for the projection years, disaggregate the ADD data to each of the ADD counties and finally disaggregate the county data to the river basin.

In order to expedite the disaggregation effort, the lead consultant in each ADD made the projections for each county in the ADD, reviewed the work with the Kentucky Department of Commerce and then shared the information with the other consultants working in the same ADD.

Miller, Wihry and Lee was the lead consultant for the Bluegrass and Kentucky River ADDs and the following information represents the work of our employment disaggregation effort.

Employment Trends Bluegrass ADD

The "at year" employment figures in EXHIBIT A-5.1t are taken from the Kentucky Department of Commerce report entitled "Employment Trends, 1950-1970, Kentucky Non-Agricultural Wage and Salary (Excluding data not classified by County)".

As presented in this EXHIBIT, non-manufacturing employment has accounted for nearly three-quarters of the total for the past twenty years, with manufacturing employment increasing its share from 19.8% to 26.3% to 26.9%.

The Bluegrass ADD's employment has represented a steadily increasing share of Kentucky's employment total, increasing from 12% in 1950 to nearly 17% in 1970.

Exhibit A-5.1t - Bluegrass A.D.D. Employment Trends "At Year" for 1950, 1960, and 1970

Employment Category	At Year Number			Percent of A.D.D. Total		
	1950	1960	1970	1950	1960	1970
Bluegrass A.D.D. Total	64,085	88,470	150,031	100	100	100
Manufacturing Total	12,700	23,257	40,401	19.8	26.3	26.9
Food & Kindred Products	4,169	3,707	3,285	6.5	4.2	2.2
Tobacco	1,040	1,973	1,614	1.6	2.2	1.1
Clothing Textile & Leather	4,138	4,898	7,149	6.4	5.5	4.7
Lumber & Furniture	696	654	955	1.1	0.7	0.6
Printing, Publishing, Paper	733	1,094	3,342	1.1	1.2	2.2
Chem., Petrol, Coal & Rubber	107	669	1,714	0.1	0.7	1.1
Stone, Clay & Glass	235	1,046	1,663	0.3	1.2	1.1
Primary Metals	0	275	968	-	0.3	0.6
Machinery, Metal Prod., & Equip.	1,401	8,019	16,445	2.2	9.1	11.0
Other Manufacturing	181	922	3,266	0.2	1.0	2.2
Non-Manufacturing Total	51,385	65,213	109,630	80.2	73.7	73.1
Trans., Comm., Util., & R.R.	6,361	6,271	7,828	9.9	7.1	5.2
Wholesale & Retail Trade	18,109	19,031	30,018	28.2	21.5	20.0
Finan., Insur., & Real Estate	2,093	3,222	6,163	3.3	3.6	4.1
Services	6,005	10,109	20,785	9.4	11.4	13.9
Government	15,113	21,590	37,359	23.6	24.4	24.9
Mining & Quarrying	425	519	367	0.6	0.5	0.2
Contract Construction	3,279	4,471	7,110	5.1	5.0	4.7

Exhibit A-5.2t - Bluegrass A.D.D. Employment Projections

Employment Category	At Year Number				Between Year Number/% Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Non-Agriculture Total	150,031	191,403	232,775	301,109	41,372/27.5	41,372/21.6	68,334/29.3
Manufacturing	40,401	53,933	67,465	83,200	13,532/33.5	13,532/25.0	15,735/23.3
Food & Kindred Products	3,285	4,370	5,464	6,740	1,085/33.0	1,094/25.0	1,276/23.3
Tobacco	1,614	2,157	2,700	3,328	543/33.6	543/25.1	628/23.2
Clothing, Textile & Leather	7,149	9,546	11,940	14,726	2,397/33.5	2,394/25.1	2,786/23.3
Lumber & Furniture	955	1,294	1,619	1,997	339/35.4	325/25.1	378/23.3
Printing, Publishing, Paper	3,342	4,476	5,600	6,906	1,134/33.9	1,124/25.1	1,306/23.3
Chem., Petrol., Coal & Rubber	1,714	2,265	2,833	3,494	551/32.1	568/25.0	661/23.3
Stone, Clay & Glass	1,663	2,211	2,766	3,411	548/32.9	555/25.1	645/23.3
Primary Metals	968	1,294	1,620	1,996	326/25.1	326/25.1	376/23.2
Mach., Metal Prod., & Equip.	16,445	21,950	27,458	33,862	5,505/33.5	5,508/25.1	6,404/23.3
Other Manufacturing	3,266	4,370	5,465	6,740	1,104/33.8	1,045/25.0	1,275/23.3
Non-Manufacturing Total	109,630	137,470	165,310	217,909	27,840/25.3	27,840/20.2	52,599/31.8
Trans., Comm., Util., & R.R.	7,828	9,481	11,135	13,793	1,653/21.1	2,658/28.0	2,658/23.8
Wholesale & Retail Trade	30,018	37,487	44,956	52,627	7,406/24.6	7,469/19.9	7,671/17.1
Finan., Insur. & Real Estate	6,163	7,858	9,553	13,960	1,695/27.5	1,695/21.6	4,407/46.1
Services	20,785	27,750	34,715	53,845	6,965/33.5	6,965/25.1	19,130/55.1
Government	37,359	46,037	54,154	69,725	8,678/23.2	8,117/17.6	15,571/28.7
Mining & Quarring	367	474	582	814	107/29.1	108/22.7	232/39.8
Contract Construction	7,110	8,662	10,215	13,145	1,552/21.8	1,553/17.9	2,930/28.6

ADD Employment Projections

EXHIBIT A-5.2t presents employment projections for the Bluegrass ADD. These projections were taken from Department of Commerce reports for 1980 and 1990, with the 1975 and 1995 projections derived by interpolations. As manufacturing subcategories were not available for the projection periods, the 1970 percentages of total manufacturing were maintained through each of the projection periods.

As can be seen in EXHIBIT A-5.2t, manufacturing employment, which represents approximately 27% total ADD employment, is expected to more than double by 1995 over the 1970 figure. The major share of manufacturing employment in the Bluegrass ADD is in the "machinery, metal projects and equipment" category with over 40% of the manufacturing total. The "clothing, textile, and leather", "other manufacturing" and "food and kindred products" represent respectively the second, third and fourth largest employment categories in the ADD.

Non-manufacturing employment in the Bluegrass ADD represented approximately 80% of the total non-agricultural employment in the ADD in 1960, decreased to 73% in 1970 and is expected to maintain this level through the study period. Within the non-manufacturing sector of the Bluegrass ADD, the "services" and "finance, insurance and real estate" categories are projected to expand most rapidly.

County Employment Projections

While past trend employment figures were available for each of the counties comprising the Bluegrass ADD, the Kentucky Department of Commerce has made no employment projections by county. Therefore, it was necessary to develop these figures and the methodology utilized was as follows: (1) for the present (1975), employment by county and by employment category reflects the existing situation; (2) for 1980 and 1995 an increasingly larger share of the total ADD employment is shifted from Fayette County to those counties which contain growth centers including Clark, Franklin, Madison, Scott, Woodford, and Jessamine. For example, Fayette County contained 51.2% of the total ADD employment in 1970 and this figure is expected to decrease to 46.4% by 1995. Conversly, Clark County, with 5.3% of ADD employment in 1970 is projected to contain 6.2% by 1995. Similar kinds of increases have been projected for each of the other counties which contain a growth center. Employment projections by Bluegrass ADD County is presented in EXHIBIT A-5.3t.

Exhibit A-5.3t Projected Non-Agriculture Employment, 1975-1995 For The Bluegrass ADD Counties

Employment Category	At Year Number			Number Change		% Change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95	1975	1980	1995
Anderson County Total	2,709	3,300	4,204	500	904	15.4	21.5	1.4	1.4	1.4
Manufacturing Total	1,079	1,350	1,664	271	314	20.0	18.8	2.0	2.0	2.0
Food & Kindred	450	562	649	112	87	19.9	13.4	10.3	10.3	10.3
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	-	-	-	-	-	-	-	-	-	-
Lumber and Furniture	-	-	-	-	-	-	-	-	-	-
Print., Publish., Paper	13	16	21	3	5	18.7	23.8	0.3	0.3	0.3
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Clay, Glass	350	437	540	87	100	19.9	19.0	15.8	15.8	15.8
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	236	295	364	59	69	20.0	18.9	5.4	5.4	5.4
Non-Mfg. Total	1,630	1,950	2,540	320	590	16.4	23.2	0.9	1.2	1.2
Mining & Quarrying	16	19	27	3	8	15.7	24.6	3.3	3.3	3.3
Construction	35	41	52	6	11	14.6	21.1	0.4	0.4	0.4
Trans., Comm., Util., & R.R.	104	122	152	18	30	14.7	19.7	1.1	1.1	1.1
Wholesale-Retail Trade	375	449	526	74	77	16.4	14.6	1.0	1.0	1.0
Finance, Insur., Real Estate	55	67	97	12	30	17.9	30.9	0.7	0.7	0.7
Services	222	277	431	55	154	19.8	35.7	0.8	0.8	0.8
Government	823	975	1,255	152	280	15.5	22.3	1.8	1.8	1.8
Bourbon County Total	4,823	5,856	7,539	1,033	1,678	17.6	22.3	2.5	2.5	2.5
Manufacturing Total	1,348	1,686	2,080	338	394	20.0	18.9	2.5	2.5	2.5
Food & Kindred	26	33	40	7	7	21.2	17.5	0.6	0.6	0.6
Tobacco	35	43	53	8	10	18.6	18.8	1.6	1.6	1.6
Clothing, Textile, Leather	945	1,194	1,427	249	233	20.8	16.3	10.0	10.0	10.0
Lumber and Furniture	8	10	12	2	2	25.0	20.0	0.6	0.6	0.6
Print., Publish., Paper	31	39	48	8	9	20.5	18.7	0.7	0.7	0.7
Chem., Petrol. Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Glass, Clay	8	11	13	3	2	27.2	23.0	0.4	0.4	0.4
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	307	384	474	77	90	20.0	18.9	1.4	1.4	1.4
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	3,475	4,170	5,454	695	1,284	16.6	23.5	2.5	2.5	2.5
Mining & Quarrying	21	26	36	5	10	19.2	27.7	4.4	4.4	4.4
Construction	242	286	369	44	83	15.4	22.5	2.8	2.8	2.8
Trans., Comm., Util., & R.R.	171	200	248	29	48	14.5	19.3	1.8	1.8	1.8
Wholesale-Retail Trade	975	1,168	1,368	193	200	16.5	14.6	2.6	2.6	2.6
Finance, Insur., Real Estate	157	191	280	34	89	17.8	31.7	2.0	2.0	2.0
Services	583	729	1,131	146	402	20.0	35.5	2.1	2.1	2.1
Government	1,326	1,570	2,022	244	452	15.5	22.3	2.9	2.9	2.9
Boyle County Total	10,161	12,413	15,904	2,252	3,491	18.1	21.9	5.3	5.3	5.3
Manufacturing Total	3,883	4,857	5,990	974	1,133	20.0	18.9	7.2	7.2	7.2
Food & Kindred	140	175	216	35	41	20.0	18.9	3.2	3.2	3.2
Tobacco	35	43	53	8	10	18.6	18.8	1.6	1.6	1.6
Clothing, Textile, Leather	1,461	1,827	2,253	366	426	20.0	18.9	15.3	15.3	15.3
Lumber and Furniture	270	336	415	66	79	19.6	19.0	20.8	20.8	20.8
Print., Publish., Paper	841	1,052	1,298	211	246	20.0	18.9	18.8	18.8	18.8
Chem., Retrol., Coal, Rubber	7	9	10	2	1	28.6	10.0	0.3	0.3	0.3
Stone, Glass, Clay	788	985	1,214	197	229	20.0	18.9	35.6	35.6	35.6
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	351	440	542	89	102	20.2	18.8	1.6	1.6	1.6
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	6,278	7,556	9,914	1,278	2,358	16.9	23.7	4.5	4.5	4.5
Mining & Quarrying	35	43	60	8	17	22.8	28.3	7.4	7.4	7.4
Construction	381	450	580	69	130	15.3	22.4	4.4	4.4	4.4
Trans., Comm., Util., & R.R.	986	1,160	1,434	174	274	15.0	19.1	10.4	10.4	10.4
Wholesale-Retail Trade	1,986	2,382	2,790	396	408	16.6	14.6	5.3	5.3	5.3
Finance, Insur., Real Estate	267	324	476	57	152	17.6	31.9	3.4	3.4	3.4
Services	1,388	1,735	2,691	347	956	20.0	50.7	5.0	5.0	5.0
Government	1,235	1,462	1,883	227	421	15.5	22.3	2.7	2.7	2.7

Exhibit A-5.3t Projected Non-Agriculture Employment, 1975-1995 For The Bluegrass ADD Counties

Employment Category	At Year Number			Number Change		% Change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95	1975	1980	1995
Clark County Total	10,278	13,501	18,669	3,223	5,168	23.9	27.7	5.3	5.8	6.2
Manufacturing Total	3,883	5,335	5,990	974	1,133	27.2	18.9	7.2	7.2	7.2
Food & Kindred	40	49	61	9	12	22.5	19.7	0.9	0.9	0.9
Tobacco	15	19	23	4	4	21.0	17.4	0.7	0.7	0.7
Clothing, Textile, Leather	535	668	825	133	157	19.9	19.0	5.6	5.6	5.6
Lumber and Furniture	586	732	903	146	171	19.9	18.9	45.2	45.2	45.2
Print., Publish., Paper	67	84	103	17	19	20.2	18.4	1.5	1.5	1.5
Chem., Petrol., Coal, Rubber	213	266	330	53	64	19.9	19.4	9.4	9.4	9.4
Stone, Clay, Glass	11	13	17	2	4	15.4	23.5	0.5	0.5	0.5
Primary Metals	637	797	982	160	185	20.1	18.8	49.2	49.2	49.2
Mach., Metal Prod., & Equip.	1,756	2,680	4,013	924	1,333	34.5	33.2	8.0	9.7	11.8
Other Manufacturing	22	27	34	5	7	18.5	20.1	0.5	0.5	0.5
Non-Mfg. Total	6,395	8,161	11,376	1,766	3,215	21.6	28.2	4.6	4.9	5.2
Mining & Quarrying	60	73	103	13	30	17.8	29.1	12.6	12.6	12.6
Construction	390	460	591	70	131	15.2	22.1	4.5	4.5	4.5
Trans., Comm., Util., & R.R.	1,033	1,214	1,503	181	289	14.9	19.2	10.9	10.9	10.9
Wholesale-Retail Trade	1,650	1,978	2,315	328	337	16.6	14.5	4.4	4.4	4.4
Finance, Insur., Real Estate	275	334	489	59	155	17.6	31.7	3.5	3.5	3.5
Services	1,249	2,045	3,725	796	1,680	38.9	45.1	4.5	5.9	6.9
Government	1,738	2,057	2,650	319	593	15.5	22.4	3.8	3.8	3.8
Estill County Total	1,826	2,200	2,809	374	609	17.0	21.6	0.9	0.9	0.9
Manufacturing Total	324	404	500	80	96	19.8	19.2	0.6	0.6	0.6
Food & Kindred	4	5	7	1	2	25.0	28.6	0.1	0.1	0.1
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	258	322	398	64	76	19.8	19.1	2.7	2.7	2.7
Lumber and Furniture	43	55	67	12	12	21.8	17.9	3.4	3.4	3.4
Print., Publish., Paper	4	5	6	1	1	20.0	16.6	0.1	0.1	0.1
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Glass, Clay	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	1,502	1,796	2,309	294	513	16.4	22.2	1.1	1.1	1.1
Mining & Quarry	55	68	95	13	27	19.1	28.4	11.7	11.7	11.7
Construction	8	10	13	2	3	25.0	23.1	0.1	0.1	0.1
Trans., Comm., Util., & R.R.	246	290	359	44	69	15.1	19.2	2.6	2.6	2.6
Wholesale-Retail Trade	337	405	473	68	68	16.7	14.4	0.9	0.9	0.9
Finance, Insur., Real Estate	31	38	55	7	17	18.4	30.9	0.4	0.4	0.4
Services	139	173	269	34	96	19.6	35.7	0.5	0.5	0.5
Government	686	812	1,045	126	233	15.5	22.3	1.5	1.5	1.5
Fayette County Total	97,955	112,750	140,323	14,795	27,573	13.1	19.6	51.2	48.4	46.4
Manufacturing Total	22,922	26,572	35,360	5,750	6,688	13.7	18.9	42.5	42.5	42.5
Food & Kindred	1,534	1,981	2,365	447	384	22.5	16.2	35.1	35.1	35.1
Tobacco	2,015	2,521	3,110	506	589	20.0	18.9	93.4	93.4	93.4
Clothing, Textile, Leather	1,480	1,477	1,582	3	105	0.2	6.6	15.5	12.4	10.7
Lumber and Furniture	188	234	290	46	56	19.6	19.3	14.5	14.5	14.5
Print., Publish., Paper	1,790	1,993	2,171	203	178	10.2	8.2	40.0	35.6	31.4
Chem., Petrol., Coal, Rubber	1,003	1,255	1,548	252	293	20.1	18.9	44.3	44.3	44.3
Stone, Glass, Clay	527	659	812	132	153	20.0	18.8	23.8	23.8	23.8
Primary Metals	56	70	86	14	16	20.0	18.6	4.3	4.3	4.3
Mach., Metal Prod., & Equip.	13,676	15,872	18,287	2,196	2,415	13.8	13.2	62.3	57.8	54.0
Other Manufacturing	656	573	419	83	154	14.5	36.7	15.0	10.5	6.2
Non-Mfg. Total	75,033	86,428	109,656	11,395	23,228	13.2	21.2	54.5	52.3	50.3
Mining & Quarry	114	140	196	26	56	18.6	28.6	24.0	24.0	24.0
Construction	5,622	6,630	8,531	1,008	1,901	15.2	22.3	64.9	64.9	64.9
Trans., Comm., Util., & R.R.	5,120	6,013	7,448	893	1,435	14.8	19.3	54.0	54.0	54.0
Wholesale-Retail Trade	21,105	24,612	28,206	3,507	3,594	14.2	12.7	56.3	54.7	53.6
Finance, Insur., Real Estate	5,375	5,965	8,339	590	2,374	9.9	28.5	68.4	62.4	59.7
Services	16,649	19,035	28,293	2,386	9,258	12.5	32.7	60.0	54.8	54.8
Government	21,048	24,033	28,643	2,985	4,610	12.4	16.1	46.0	44.3	41.1

Exhibit A-5.3t Projected Non-Agriculture Employment, 1975-1995 For The Bluegrass ADD Counties

Employment Category	At Year Number			Number Change		% Change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95	1975	1980	1995
Gerrard County Total	2,074	2,521	3,156	447	635	17.7	20.1	1.0	1.0	1.0
Manufacturing Total	809	1,012	1,248	203	236	20.0	18.9	1.5	1.5	1.5
Food & Kindred	8	11	13	3	2	27.2	15.4	0.2	0.2	0.2
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	430	537	663	107	126	19.9	19.0	4.5	4.5	4.5
Lumber and Furniture	39	50	60	11	10	22.0	16.6	3.0	3.0	3.0
Print., Publish., Paper	9	10	14	1	4	11.1	28.6	0.2	0.2	0.2
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Clay, Glass	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	306	385	472	79	87	20.5	18.4	7.0	7.0	7.0
Non-Mfg Total	1,265	1,509	1,908	244	399	16.2	20.9	0.8	0.8	0.8
Mining & Quarrying	35	43	60	8	17	18.6	28.3	7.4	7.4	7.4
Construction	35	41	52	6	11	14.6	21.1	0.4	0.4	0.4
Trans., Comm., Util., & R.R.	123	144	180	21	36	14.6	20.0	1.3	1.3	1.3
Wholesale-Retail Trade	450	540	631	90	91	16.6	14.4	1.2	1.2	1.2
Finance, Insur., Real Estate	63	76	111	13	35	17.1	31.5	0.8	0.8	0.8
Services	56	70	107	14	37	20.0	34.6	0.2	0.2	0.2
Government	503	595	767	92	172	15.4	22.4	1.1	1.1	1.1
Harrison County Total	4,577	5,609	7,185	1,032	1,576	18.4	21.9	2.4	2.4	2.4
Manufacturing Total	1,942	2,428	2,995	486	567	20.0	18.9	3.6	3.6	3.6
Food & Kindred	197	246	303	49	57	19.9	18.8	4.5	4.5	4.5
Tobacco	15	19	23	4	4	21.0	17.4	0.7	0.7	0.7
Clothing, Textile, Leather	286	359	442	73	83	20.3	18.7	3.0	3.0	3.0
Lumber and Furniture	1	2	2	1	0	50.0	0.0	0.1	0.1	0.1
Print., Publish., Paper	22	28	34	6	6	21.4	17.6	0.5	0.5	0.5
Chem., Petrol., Coal, Rubber	70	88	108	18	20	20.4	18.5	3.1	3.1	3.1
Stone, Glass, Clay	8	11	13	3	2	27.2	15.4	0.4	0.4	0.4
Primary Metals	241	301	371	60	70	19.9	18.8	18.6	18.6	18.6
Mach., Metal Prod., & Equip.	880	1,100	1,355	220	255	20.0	18.8	4.0	4.0	4.0
Other Manufacturing	253	317	391	64	74	20.2	18.9	5.8	5.8	5.8
Non-Mfg. Total	2,635	3,181	4,190	546	1,009	17.2	24.1	1.9	1.9	1.9
Mining & Quarrying	22	27	37	5	10	18.5	27.0	4.6	4.6	4.6
Construction	61	72	92	11	20	15.3	21.7	0.7	0.7	0.7
Trans., Comm., Util., & R.R.	142	167	206	25	39	14.9	18.9	1.5	1.5	1.5
Wholesale-Retail Trade	937	1,123	1,316	186	193	16.5	14.6	2.5	2.5	2.5
Finance, Insur., Real Estate	204	250	363	46	113	18.4	31.1	2.6	2.6	2.6
Services	583	730	1,130	147	400	20.1	35.4	2.1	2.1	2.1
Government	686	812	1,046	126	234	15.5	22.4	1.5	1.5	1.5
Jessamine County Total	2,976	4,888	7,227	1,912	2,339	39.1	32.3	1.6	2.1	2.4
Manufacturing Total	324	416	500	84	92	22.1	18.4	0.6	0.6	0.6
Food & Kindred	140	175	216	35	41	20.0	19.0	3.2	3.2	3.2
Tobacco	2	3	3	1	0	33.3	0.0	0.1	0.1	0.1
Clothing, Textile, Leather	143	180	221	37	41	20.5	18.5	1.5	1.5	1.5
Lumber and Furniture	15	20	23	5	3	25.0	13.0	1.2	1.2	1.2
Print., Publish., Paper	8	11	14	3	3	27.3	21.4	0.2	0.2	0.2
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Glass, Clay	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	21	27	33	6	6	22.2	18.2	0.1	0.1	0.1
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	2,654	4,480	6,727	1,826	2,247	40.7	33.4	1.9	2.7	3.1
Mining & Quarrying	30	38	53	8	15	26.6	28.3	6.5	6.5	6.5
Construction	190	224	290	34	66	15.2	22.7	2.2	2.2	2.2
Trans., Comm., Util., & R.R.	114	134	165	20	31	14.9	18.8	1.2	1.2	1.2
Wholesale-Retail Trade	524	951	1,355	427	404	44.9	29.8	1.4	2.1	2.6
Finance, Insur., Real Estate	86	426	771	340	345	79.8	44.7	1.1	4.4	5.5
Services	610	1,085	1,802	475	717	43.8	39.8	2.2	3.1	3.3
Government	1,100	1,374	2,291	522	669	32.2	29.2	2.5	3.0	3.3

Exhibit A-5.3t Projected Non-Agriculture Employment, 1975-1995 For The Bluegrass ADD Counties

Employment Category	At Year Number			Number Change		% Change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95	1975	1980	1995
Lincoln County Total	2,683	3,264	4,156	581	893	17.8	21.5	1.4	1.4	1.4
Manufacturing Total	969	1,214	1,498	245	284	20.2	18.9	1.8	1.8	1.8
Food & Kindred	66	82	101	16	19	19.5	18.8	1.5	1.5	1.5
Tobacco	2	3	3	1	0	33.3	0	0.1	0.1	0.1
Clothing, Textile, Leather	430	537	663	107	126	19.9	19.0	4.5	4.5	4.5
Lumber and Furniture	93	116	145	23	29	19.8	20.0	7.2	7.2	7.2
Print., Publish., Paper	4	5	6	1	1	20.0	16.0	0.1	0.1	0.1
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Clay, Glass	11	13	17	2	4	15.3	23.5	0.5	0.5	0.5
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	373	466	576	93	110	19.9	19.1	1.7	1.7	1.7
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	1,714	2,050	2,658	336	608	16.4	22.8	1.2	1.2	1.2
Mining & Quarrying	-	-	-	-	-	-	-	-	-	-
Construction	70	82	105	12	23	14.6	21.9	0.8	0.8	0.8
Trans., Comm., Util., & R.R.	123	145	180	22	35	15.1	19.4	1.3	1.3	1.3
Wholesale-Retail Trade	450	539	631	89	92	16.5	14.6	1.2	1.2	1.2
Finance, Insur., Real Estate	71	86	126	15	40	17.4	31.7	0.9	0.9	0.9
Services	222	278	431	56	153	20.1	35.5	0.8	0.8	0.8
Government	778	920	1,185	142	265	15.4	22.3	1.7	1.7	1.7
Madison County Total	15,267	20,040	27,100	4,773	7,060	23.8	26.0	8.0	8.6	9.0
Manufacturing Total	3,721	4,655	5,741	934	1,086	20.0	18.9	6.9	6.9	6.9
Food & Kindred	114	142	175	28	33	19.7	18.8	2.6	2.6	2.6
Tobacco	20	27	33	7	6	25.9	18.2	1.0	1.0	1.0
Clothing, Textile, Leather	76	95	118	19	23	20.0	19.5	0.8	0.8	0.8
Lumber and Furniture	1	2	2	1	0	50.0	0.0	0.1	0.1	0.1
Print., Publish., Paper	447	560	690	113	130	20.2	18.8	10.0	10.0	10.0
Chem., Petrol., Coal, Rubber	834	1,042	1,286	208	244	19.9	19.0	36.8	36.8	36.8
Stone, Glass, Clay	310	387	477	77	90	19.9	18.8	14.0	14.0	14.0
Primary Metals	104	130	160	26	30	20.0	18.7	8.0	8.0	8.0
Mach., Metal Prod., & Equip.	1,450	2,124	3,040	738	852	33.7	28.0	6.6	7.7	9.0
Other Manufacturing	341	426	526	85	100	19.9	19.0	7.8	7.8	7.8
Non-Mfg. Total	11,546	15,009	20,554	3,463	5,545	23.1	27.0	8.4	9.0	9.4
Mining & Quarrying	-	-	-	-	-	-	-	-	-	-
Construction	381	450	580	69	130	15.3	22.4	4.4	4.4	4.4
Trans., Comm., Util., & R.R.	284	334	414	50	80	15.0	19.3	3.0	3.0	3.0
Wholesale-Retail Trade	3,598	4,628	5,858	1,095	1,165	23.3	19.9	9.6	10.3	11.1
Finance, Insur., Real Estate	259	315	461	56	146	17.8	31.7	3.3	3.3	3.3
Services	2,220	3,089	5,114	934	1,960	29.6	38.3	8.0	8.9	9.5
Government	4,804	5,999	8,122	1,259	2,064	20.7	25.4	10.5	11.1	11.6
Mercer County Total	4,897	5,970	7,609	1,073	1,639	17.9	21.5	2.6	2.6	2.6
Manufacturing Total	1,888	2,361	2,912	473	551	20.0	18.9	3.5	3.5	3.5
Food & Kindred	87	109	135	22	26	20.0	19.2	2.0	2.0	2.0
Tobacco	10	13	17	3	4	23.0	23.5	0.5	0.5	0.5
Clothing, Textile, Leather	859	1,074	1,325	215	251	20.0	18.9	9.0	9.0	9.0
Lumber and Furniture	17	21	26	4	5	19.0	19.2	1.3	1.3	1.3
Print., Publish., Paper	20	22	28	2	6	0.9	21.4	0.4	0.4	0.4
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Glass, Clay	161	203	250	42	47	20.6	18.8	7.3	7.3	7.3
Primary Metals	6	8	10	2	2	25.0	20.0	0.5	0.5	0.5
Mach., Metal Prod., & Equip.	21	27	33	6	6	22.2	18.1	0.1	0.1	0.1
Other Manufacturing	712	890	1,098	178	208	20.0	18.9	16.3	16.3	16.3
Non-Mfg. Total	3,009	3,609	4,697	600	1,088	16.6	23.2	2.1	2.1	2.1
Mining & Quarrying	20	25	35	5	10	20.0	28.6	4.3	4.3	4.3
Construction	242	286	368	44	82	15.3	22.2	2.8	2.8	2.8
Trans., Comm., Util., & R.R.	220	256	317	36	61	14.0	19.2	2.3	2.3	2.3
Wholesale-Retail Trade	900	1,080	1,263	180	183	16.6	14.4	2.4	2.4	2.4
Finance, Insur., Real Estate	150	181	265	31	84	17.1	31.7	1.9	1.9	1.9
Services	470	590	915	120	325	20.3	35.5	1.7	1.7	1.7
Government	1,007	1,191	1,534	184	343	15.4	22.3	2.2	2.2	2.2

Exhibit A-5.3t Projected Non-Agriculture Employment, 1975-1995 For The Bluegrass ADD Counties

Employment Category	At Year Number			Number Change		% Change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95	1975	1980	1995
Nicholas County Total	1,668	2,042	2,561	374	519	18.3	20.3	0.9	0.9	0.9
Manufacturing Total	863	1,080	1,331	217	251	20.1	18.8	1.6	1.6	1.6
Food & Kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	859	1,074	1,325	215	251	20.0	18.9	9.0	9.0	9.0
Lumber and Furniture	-	-	-	-	-	-	-	-	-	-
Print., Publish., Paper	4	5	6	1	1	20.0	16.6	0.1	0.1	0.1
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Clay, Glass	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	21	27	33	6	6	22.2	18.2	0.1	0.1	0.1
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	805	962	1,230	157	268	16.3	21.7	0.5	0.5	0.5
Mining & Quarrying	-	-	-	-	-	-	-	-	-	-
Construction	17	20	26	3	6	15.0	23.0	0.2	0.2	0.2
Trans., Comm., Util., & R.R.	10	11	14	1	3	9.0	21.4	0.1	0.1	0.1
Wholesale-Retail Trade	225	270	316	45	46	16.6	14.5	0.6	0.6	0.6
Finance, Insur., Real Estate	40	50	70	10	20	20.0	28.5	0.5	0.5	0.5
Services	56	70	107	14	37	20.0	34.5	0.2	0.2	0.2
Government	451	541	697	84	156	15.5	22.3	1.0	1.0	1.0
Powell County Total	1,371	1,647	2,092	276	445	16.7	21.2	0.8	0.8	0.8
Manufacturing Total	324	405	500	81	95	20.0	19.0	0.6	0.6	0.6
Food & Kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	238	300	368	62	68	20.6	18.4	2.5	2.5	2.5
Lumber and Furniture	32	40	50	8	10	20.0	20.0	2.5	2.5	2.5
Print., Publish., Paper	4	6	6	2	0	33.0	0	0.1	0.1	0.1
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Glass, Clay	35	44	55	9	11	20.4	20.0	1.6	1.6	1.6
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	1,047	1,242	1,592	195	350	15.7	21.9	0.7	0.7	0.7
Mining & Quarrying	32	40	55	8	15	20.0	27.2	6.8	6.8	6.8
Construction	70	82	105	12	23	14.6	21.9	0.8	0.8	0.8
Trans., Comm., Util., & R.R.	57	66	83	9	17	13.6	20.4	0.6	0.6	0.6
Wholesale-Retail Trade	188	224	263	36	39	16.1	14.8	0.5	0.5	0.5
Finance, Insur., Real Estate	31	38	56	7	18	18.4	32.1	0.4	0.4	0.4
Services	28	34	54	6	20	17.6	37.0	0.1	0.1	0.1
Government	641	758	976	117	218	15.4	22.3	1.4	1.4	1.4
Scott County Total	4,527	5,586	7,829	1,059	2,243	18.9	28.6	2.3	2.4	2.6
Manufacturing Total	1,780	2,226	2,745	446	519	20.0	18.9	3.3	3.3	3.3
Food & Kindred	8	11	13	3	2	27.3	15.4	0.2	0.2	0.2
Tobacco	2	3	3	1	0	33.3	0	0.1	0.1	0.1
Clothing, Textile, Leather	-	-	-	-	-	-	-	-	-	-
Lumber and Furniture	2	2	2	0	0	0	0	0.1	0.1	0.1
Print., Publish., Paper	13	17	20	4	3	23.5	15.0	0.3	0.3	0.3
Chem., Petrol., Coal, Rubber	127	159	195	32	36	20.1	18.4	5.6	5.6	5.6
Stone, Glass, Clay	-	-	-	-	-	-	-	-	-	-
Primary Metals	232	290	357	58	67	20.0	18.7	17.9	17.9	17.9
Mach., Metal Prod., & Equip.	1,207	1,510	1,862	303	352	20.0	18.9	5.5	5.5	5.5
Other Manufacturing	180	224	276	44	52	19.6	18.8	4.1	4.1	4.1
Non-Mfg. Total	2,746	3,360	5,084	614	1,724	18.3	33.9	2.0	2.0	2.3
Mining & Quarrying	29	34	48	5	14	14.7	29.1	5.9	5.9	5.9
Construction	113	132	170	19	38	14.4	22.3	1.3	1.3	1.3
Trans., Comm., Util., & R.R.	123	145	180	22	55	15.2	19.4	1.3	1.3	1.3
Wholesale-Retail Trade	750	900	1,053	150	153	16.7	14.5	2.0	2.0	2.0
Finance, Insur., Real Estate	141	172	251	31	79	18.0	31.5	1.8	1.8	1.8
Services	583	730	1,130	147	400	20.1	35.4	2.1	2.1	2.1
Government	1,007	1,247	2,252	240	1,005	19.2	44.6	2.2	2.3	3.2

Exhibit A-5.3t Projected Non-Agriculture Employment, 1975-1995 For The Bluegrass ADD Counties

Employment Category	At Year Number			Number Change		% Change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95	1975	1980	1995
Woodford County Total	6,183	8,845	12,645	2,662	3,800	30.1	30.0	3.2	3.8	4.2
Manufacturing Total	3,559	4,968	5,491	894	1,038	28.3	18.9	6.6	6.6	6.6
Food & Kindred	686	858	1,060	172	202	20.0	19.0	15.7	15.7	15.7
Tobacco	2	3	3	1	0	33.3	0	0.1	0.1	0.1
Clothing, Textile, Leather	152	191	235	39	44	20.4	18.7	1.6	1.6	1.6
Lumber and Furniture	-	-	-	-	-	-	-	-	-	-
Print., Publish., Paper	1,087	1,608	2,269	521	661	32.4	29.1	24.3	28.7	32.8
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Clay, Glass	-	-	-	-	-	-	-	-	-	-
Primary Metals	18	24	30	6	6	25.0	20.0	1.5	1.5	1.5
Mach., Metal Prod., & Equip.	636	797	983	161	186	20.2	18.9	2.9	2.9	2.9
Other Manufacturing	991	1,487	2,122	496	635	33.3	29.9	22.7	27.2	31.5
Non-Mfg. Total	2,623	3,898	5,971	1,275	2,073	32.7	34.7	1.9	2.3	2.7
Mining & Quarrying	-	-	-	-	-	-	-	-	-	-
Construction	113	132	170	19	38	14.4	22.3	1.3	1.3	1.3
Trans., Comm., Util., & R.R.	170	200	248	30	48	15.0	19.3	1.8	1.8	1.8
Wholesale-Retail Trade	525	630	737	105	107	16.7	14.5	1.4	1.4	1.4
Finance, Insur., Real Estate	133	410	829	277	419	67.5	50.5	1.7	4.3	5.9
Services	583	978	1,722	395	744	40.4	43.2	2.1	2.8	3.2
Government	1,100	1,300	2,265	448	717	28.9	31.6	2.4	2.4	3.2
Franklin County Total	17,425	22,601	30,111	5,176	7,510	22.9	24.9	9.1	9.7	10.0
Manufacturing Total	4,315	5,397	8,041	1,082	2,644	20.0	32.9	8.0	8.0	9.7
Food & Kindred	870	1,088	1,341	218	253	20.0	18.9	19.9	19.9	19.9
Tobacco	2	3	3	1	-	33.3	-	0.1	0.1	0.1
Clothing, Textile, Leather	1,384	2,105	2,836	721	731	34.2	25.8	14.5	17.6	19.2
Lumber and Furniture	-	-	-	-	-	-	-	-	-	-
Print., Publish., Paper	112	140	172	28	32	20.0	18.6	2.5	2.5	2.5
Chem., Petrol., Coal, Rubber	11	14	17	3	3	21.4	17.6	0.5	0.5	0.5
Stone Glass, Clay	2	3	3	1	-	33.3	-	0.1	0.1	0.1
Primary Metals	-	-	-	-	-	-	-	-	-	
Mach., Metal Prod., & Equip.	1,251	1,940	2,631	689	691	35.5	26.3	5.7	7.0	7.7
Other Manufacturing	673	841	1,038	168	197	19.9	18.9	15.4	15.4	15.4
Non-Mfg. Total	13,110	16,455	22,054	3,345	5,599	20.3	25.4	9.5	9.9	10.1
Mining & Quarrying	5	6	9	1	3	16.7	33.3	1.1	1.1	1.1
Construction	692	817	1,051	125	234	15.3	22.2	8.0	8.0	8.0
Trans., Comm., Util., & R.R.	455	534	662	79	128	14.8	19.3	4.8	4.8	4.8
Wholesale-Retail Trade	2,511	3,012	3,526	501	514	16.6	14.6	6.7	6.7	6.7
Finance, Insur., Real Estate	520	630	921	110	291	17.5	31.6	6.6	6.6	6.6
Services	2,109	3,012	4,793	903	1,781	30.0	37.1	7.6	8.7	8.9
Government	6,818	8,444	11,092	1,626	2,648	19.2	23.9	14.9	15.6	15.9

Employment Trends Kentucky River ADD

The "at year" employment figures in EXHIBIT A-5.4t are taken from the Kentucky Department of Commerce report entitled "Employment Trends, 1950-1970, Kentucky Non-Agricultural Wage and Salary (Excluding data not classified by County)".

As can be seen in this EXHIBIT, employment in the Kentucky River ADD declined by over 4,000 workers between 1950 and 1960, then increased to near the 1950 total in 1970. Non-manufacturing employment constitutes more than 96% of total employment in the ADD, with "mining and quarrying" and "government" the chief employers, followed by "services" and "wholesale and retail trade".

Manufacturing employment in the ADD, stifled by access and suitable sites, constitutes less than 4% of employment in the ADD. "Lumber and furniture", "food and kindred products" and "machinery, metal products and equipment" have been the principal manufacturing categories in the past in the Kentucky River ADD.

ADD Employment Projections

EXHIBIT A-5.5t presents employment projections for the Kentucky River ADD. These projections were taken from Department of Commerce reports for 1980 and 1990, with the 1975 and 1995 projections derived by interpolations. As manufacturing subcategories were not available for the projection periods, the 1970 percentages of total manufacturing were maintained through each of the projection periods.

As can be seen in EXHIBIT A-5.5t non-manufacturing employment is expected to more than double by 1995 over the 1970 figure. Within the non-manufacturing sector of the Kentucky River ADD "mining and quarrying", "government" and the "services" categories are expected to expand most rapidly.

Manufacturing employment in the ADD is expected to increase only slightly during the study period.

Exhibit A-5.4t Kentucky River A.D.D. Employment Trends "At Year" for 1950, 1960, and 1970

Employment Category	At Year Number			Percent of A.D.D. Total		
	1950	1960	1970	1950	1960	1970
Kentucky River A.D.D. Total	19,605	15,225	19,275	100	100	100
Manufacturing Total	1,132	724	730	5.8	4.8	3.8
Food & Kindred Products	152	153	164	0.7	1.0	0.8
Tobacco	0	1	2	-	.006	.01
Clothing, Textile & Leather	0	0	116	-	-	0.6
Lumber & Furniture	938	526	243	4.7	3.4	1.2
Printing, Publishing, Paper	34	15	42	0.1	0.09	0.2
Chem., Petrol., Coal & Rubber	3	0	0	0.01	-	-
Stone, Clay & Glass	5	20	32	0.02	0.1	0.2
Primary Metals	0	0	0	-	-	-
Machinery, Metal Prod., & Equip.	0	4	131	-	0.02	0.6
Other Manufacturing	0	5	0	-	0.6	-
Non-Manufacturing Total	18,473	14,501	18,545	94.2	95.2	96.2
Trans., Comm., Util., & R.R.	1,038	601	816	5.3	3.9	4.2
Wholesale & Retail Trade	1,864	2,271	2,722	9.5	14.9	14.1
Finan., Insur., & Real Estate	144	219	521	0.7	1.4	2.7
Services	806	1,297	2,876	4.1	8.5	14.9
Government	2,091	3,005	5,930	10.6	19.7	30.7
Mining & Quarrying	12,399	6,884	5,378	63.2	45.2	27.9
Contract Construction	131	224	302	0.6	14.7	1.5

Exhibit A-5.5t Kentucky River A.D.D. Employment Projections

Employment Category	At Year Number				Between Year Number/% Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Non-Agriculture Total	19,275	24,007	28,739	38,667	4,732/24.5	4,732/19.7	9,928/34.5
Manufacturing	730	736	743	751	6/ 0.8	7/ 0.9	8/ 0.1
Food & Kindred Products	164	166	167	169	2/ 0.1	3/ 0.2	2/ 0.1
Tobacco	2	2	3	3	-	1/50.0	-
Clothing, Textile & Leather	116	116	117	119	-	1/ 0.8	2/ 1.7
Lumber & Furniture	243	245	247	250	2/ 0.8	2/ 0.8	3/ 1.2
Printing, Publishing, Paper	42	43	43	43	1/ 2.4	-	-
Chem., Petrol., Coal & Rubber	-	-	-	-	-	-	-
Stone, Clay & Glass	32	32	33	33	-	1/ 3.1	-
Primary Metals	-	-	-	-	-	-	-
Mach., Metal Prod. & Equip.	131	132	133	135	1/ 0.7	1/ 0.7	2/ 1.5
Other Manufacturing	-	-	-	-	-	-	-
Non-Manufacturing Total	18,545	23,271	27,996	37,916	4,726/25.5	4,725/20.3	9,920/35.4
Trans., Comm., Util., & R.R.	816	1,044	1,273	1,640	228/27.9	229/21.9	367/28.8
Wholesale & Retail Trade	2,722	3,030	3,339	3,655	308/11.3	309/10.2	316/ 9.5
Finan., Insur. & Real Estate	521	695	869	1,322	174/33.4	174/25.0	453/52.1
Services	2,876	3,905	4,935	7,762	1,029/35.7	1,030/26.4	2,827/57.3
Government	5,930	7,488	9,046	11,935	1,558/26.3	1,558/20.8	2,889/31.9
Mining & Quarrying	5,378	6,759	8,140	11,120	1,381/25.6	1,318/20.4	2,980/36.6
Contract Construction	302	348	394	481	46/15.2	46/13.2	87/22.1

County Employment Projections

While past trend employment figures were available for each of the counties comprising the Kentucky River ADD, the Kentucky Department of Commerce has made no employment projection by county. Therefore, it was decided to maintain each county's existing percentage of ADD employment through each of the projection periods along with the existing percentage of ADD total employment by subcategory.

Employment projections by Kentucky River ADD County is presented in EXHIBIT A-5.6t. As can be seen by the EXHIBIT, Perry and Letcher Counties contain the bulk of the Kentucky River ADD employment with 34.1% and 27.4% respectively. Owsley County, with only 462 nonagricultural employees contains 2.3% of total ADD employment.

Exhibit A-5.6t Projected Non-Agriculture Employment, 1975-1995 For The Kentucky River ADD Counties

Employment Category	At Year Number			Number Change		% Change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95	1975	1980	1995
Breathitt County Total	2,953	3,557	4,848	604	1,291	20.4	36.3	12.3	12.4	12.5
Manufacturing Total	74	74	75	0	1	0	1.4	10.0	10.0	10.0
Food & Kindred	25	25	26	0	1	0	4.0	15.0	15.0	15.0
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	-	-	-	-	-	-	-	-	-	-
Lumber and Furniture	20	20	21	0	1	0	5.0	8.2	8.2	8.2
Print. Publish, Paper	16	16	16	0	0	0	0	38.1	38.1	38.1
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Clay, Glass	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	9	9	9	0	0	0	0	7.0	7.0	7.0
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	2,879	3,483	4,773	604	1,290	21.0	37.0	12.0	12.1	12.3
Mining & Quarrying	277	334	456	57	122	20.6	36.5	4.1	4.1	4.1
Construction	11	12	14	1	2	9.1	16.7	3.0	3.0	3.0
Trans., Comm., Util., & R.R.	81	98	126	17	28	21.0	28.6	7.8	7.7	7.7
Wholesale-Retail Trade	364	400	439	36	39	9.9	9.8	12.0	12.0	12.0
Finance, Insur., Real Estate	67	84	127	17	43	25.4	51.2	9.6	9.6	9.6
Services	754	953	1,499	199	546	26.4	57.3	19.3	19.3	19.3
Government	1,325	1,602	2,112	277	510	20.9	31.8	17.7	17.7	17.7
Knott County Total	2,052	2,458	3,244	406	786	19.8	32.0	8.5	8.5	8.4
Manufacturing Total	6	6	6	0	0	0	0	0.8	0.8	0.8
Food & Kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	-	-	-	-	-	-	-	-	-	-
Lumber and Furniture	6	6	6	0	0	0	0	2.5	2.5	2.5
Print., Publish., Paper	-	-	-	-	-	-	-	-	-	-
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Glass, Clay	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	2,046	2,452	3,238	406	786	16.5	24.3	8.5	8.5	8.4
Mining & Quarry	807	610	834	103	224	16.9	26.8	7.5	7.5	7.5
Construction	56	64	78	8	14	12.5	17.9	16.2	16.2	16.2
Trans., Comm., Util., & R.R.	108	131	169	23	38	17.5	22.5	10.3	10.3	10.3
Wholesale-Retail Trade	194	214	234	20	20	9.3	8.5	6.4	6.4	6.4
Finance, Insur., Real Estate	24	30	46	6	16	20.0	34.8	3.5	3.5	3.5
Services	86	109	170	23	61	21.1	35.9	2.2	2.2	2.2
Government	1,071	1,294	1,707	223	413	17.2	24.2	14.3	14.3	14.3
Lee County Total	1,208	1,410	1,785	202	375	14.3	21.0	5.0	5.0	4.6
Manufacturing Total	158	160	162	2	2	1.2	1.2	21.5	21.5	21.5
Food & Kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	116	117	119	1	2	0.8	1.7	100.0	100.0	100.0
Lumber and Furniture	23	24	24	1	0	4.1	0	9.5	9.5	9.5
Print., Publish., Paper	-	-	-	-	-	-	-	-	-	-
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Glass, Clay	18	19	19	1	0	5.2	0	56.2	56.2	56.2
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	1,050	1,250	1,623	200	373	16.0	23.0	4.4	4.3	4.2
Mining & Quarry	142	170	233	28	63	16.5	27.0	2.1	2.1	2.1
Construction	11	13	16	2	3	15.9	18.7	3.3	3.3	3.3
Trans., Comm., Util., & R.R.	95	116	149	21	33	18.1	22.1	9.1	9.1	9.1
Wholesale-Retail Trade	195	214	239	20	20	9.3	8.5	6.4	6.4	6.4
Finance, Insur., Real Estate	26	33	50	7	17	21.2	34.0	3.8	3.8	3.8
Services	35	44	70	9	26	20.4	37.1	0.9	0.9	0.9
Government	547	660	871	113	211	17.1	24.2	7.3	7.3	7.3

Exhibit A-5.6t Projected Non-Agriculture Employment, 1975-1995 For The Kentucky River ADD Counties

Employment Category	At Year Number			Number Change		% Change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95	1975	1980	1995
Leslie County Total	1,666	2,001	2,688	335	687	16.7	25.5	7.0	7.0	7.0
Manufacturing Total	43	43	43	0	0	0	0	5.8	5.8	5.8
Food & Kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	-	-	-	-	-	-	-	-	-	-
Lumber and Furniture	43	44	44	1	0	2.2	0	17.7	17.7	17.7
Print., Publish., Paper	-	-	-	-	-	-	-	-	-	-
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Clay, Glass	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	1,623	1,958	2,645	335	687	17.1	26.0	6.7	6.8	6.8
Mining & Quarrying	324	390	534	66	144	16.9	27.0	4.8	9.8	4.8
Construction	9	10	12	1	2	10.0	16.6	2.6	2.6	2.6
Trans., Comm., Util., & R.R.	26	32	41	6	9	18.7	22.0	2.5	2.5	2.5
Wholesale-Retail Trade	154	170	186	16	16	9.4	8.6	5.1	5.1	5.1
Finance, Insur., Real Estate	26	33	50	7	17	21.2	34.0	3.8	3.8	3.8
Services	238	301	473	63	172	21.0	36.3	6.1	6.1	6.1
Government	846	1,022	1,349	176	327	17.2	24.2	11.3	11.3	11.3
Letcher County Total	6,561	7,827	10,490	1,266	2,663	16.2	25.4	27.3	27.2	27.1
Manufacturing Total	223	226	228	3	2	1.3	0.9	30.4	30.4	30.4
Food & Kindred	73	74	74	1	0	1.3	0	44.0	44.0	44.0
Tobacco	2	3	2	1	1	33.3	50.0	100.0	100.0	100.0
Clothing, Textile, Leather	-	-	-	-	-	-	-	-	-	-
Lumber and Furniture	127	127	129	0	2	0	1.5	51.4	51.4	51.4
Print., Publish., Paper	9	9	9	0	0	0	0	21.4	21.4	21.4
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Glass, Clay	14	14	14	0	0	0	0	43.8	43.8	43.8
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	6,338	7,601	10,262	1,263	2,661	16.6	25.9	26.4	26.4	26.5
Mining & Quarry	3,319	4,000	5,460	681	1,460	17.0	26.7	49.1	49.1	49.1
Construction	150	170	208	20	38	11.7	18.3	43.1	43.1	43.1
Trans., Comm., Util., & R.R.	175	214	276	39	62	18.2	14.1	16.8	16.8	16.8
Wholesale-Retail Trade	779	858	939	79	81	9.2	8.6	25.7	25.7	25.7
Finance, Insur., Real Estate	257	322	490	65	168	20.2	34.3	37.0	37.0	37.0
Services	625	789	1,242	164	453	20.8	36.5	16.0	16.0	16.0
Government	1,033	1,248	1,647	215	399	17.2	29.2	13.8	13.8	13.8
Owsley County Total	579	697	922	118	225	16.9	24.4	2.4	2.4	2.4
Manufacturing Total	-	-	-	-	-	-	-	-	-	-
Food & Kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	-	-	-	-	-	-	-	-	-	-
Lumber and Furniture	-	-	-	-	-	-	-	-	-	-
Print., Publish., Paper	-	-	-	-	-	-	-	-	-	-
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Glass, Clay	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	579	697	922	118	225	16.9	24.4	2.4	2.4	2.4
Mining & Quarry	-	-	-	-	-	-	-	-	-	-
Construction	10	11	13	1	2	9.1	15.4	2.7	2.7	2.7
Trans., Comm., Util., & R.R.	-	-	-	-	-	-	-	-	-	-
Wholesale-Retail Trade	24	27	29	3	2	11.1	6.9	0.8	0.8	0.8
Finance, Insur., Real Estate	19	24	37	5	13	20.8	35.1	2.8	2.8	2.8
Services	16	20	31	4	11	20.0	35.5	0.4	0.4	0.4
Government	510	615	812	105	197	17.1	24.2	6.8	6.8	6.8

Exhibit A-5.6t Projected Non-Agriculture Employment, 1975-1995 For The Kentucky River ADD Counties

Employment Category	At Year Number			Number Change		% Change		% of ADD Categ.		
	1975	1980	1995	1975-80	1980-95	1975-80	1980-95	1975	1980	1995
Perry County Total	8,218	9,891	13,545	1,673	3,654	16.9	27.0	34.2	34.4	35.0
Manufacturing Total	105	105	107	0	2	0	1.9	14.2	14.2	14.2
Food & Kindred	68	68	69	0	1	0	1.9	41.0	41.0	41.0
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	-	-	-	-	-	-	-	-	-	-
Lumber and Furniture	21	21	21	0	0	0	0	8.6	8.6	8.6
Printing, Publish., Paper	18	18	18	0	0	0	0	40.5	40.5	40.5
Chem., Petro., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Clay, Glass	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	-	-	-	-	-	-	-	-	-	-
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	8,113	9,786	13,438	1,673	3,652	17.1	27.2	33.8	34.0	34.7
Mining & Quarrying	2,170	2,612	3,570	442	958	16.9	26.8	32.1	32.1	32.1
Construction	98	111	136	13	25	11.7	18.4	28.2	28.2	28.2
Trans., Comm., Util., & R.R.	547	667	859	120	192	18.0	22.3	52.4	52.4	52.4
Wholesale-Retail Trade	1,231	1,356	1,484	125	128	9.2	8.6	40.6	40.6	40.6
Finance, Insur., Real Estate	259	323	492	64	169	19.8	34.3	37.2	37.2	37.2
Services	2,101	2,655	4,176	559	1,521	21.0	36.4	53.8	53.8	53.8
Government	1,707	2,062	2,721	355	659	17.2	24.2	22.8	22.8	22.8
Wolfe County Total	770	898	1,144	128	246	14.2	21.5	3.2	3.1	3.0
Manufacturing Total	127	129	130	2	1	1.5	0.8	17.3	17.3	17.3
Food & Kindred	-	-	-	-	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-
Clothing, Textile, Leather	-	-	-	-	-	-	-	-	-	-
Lumber and Furniture	5	5	5	0	0	0	0	2.1	2.1	2.1
Print., Publish., & Paper	-	-	-	-	-	-	-	-	-	-
Chem., Petrol., Coal, Rubber	-	-	-	-	-	-	-	-	-	-
Stone, Clay, Glass	-	-	-	-	-	-	-	-	-	-
Primary Metals	-	-	-	-	-	-	-	-	-	-
Mach., Metal Prod., & Equip.	123	124	126	1	2	0.8	1.6	93.0	93.0	93.0
Other Manufacturing	-	-	-	-	-	-	-	-	-	-
Non-Mfg. Total	643	769	1,014	126	245	16.4	24.1	2.7	2.7	2.6
Mining & Quarrying	20	24	33	4	9	16.7	27.3	0.3	0.3	0.3
Construction	3	3	4	0	1	0	25.0	0.9	0.9	0.9
Trans., Comm., Util., & R.R.	13	15	20	2	5	13.3	25.0	1.2	1.2	1.2
Wholesale-Retail Trade	91	100	110	9	10	9.0	9.1	3.0	3.0	3.0
Finance, Insur., Real Estate	16	20	30	4	10	20.0	33.3	2.3	2.3	2.3
Services	51	64	101	13	37	20.3	36.6	1.3	1.3	1.3
Government	449	543	716	94	173	17.3	24.2	6.0	6.0	6.0

LAND USE DISAGGREGATION

LAND USE DISAGGREGATION

Introduction

In formulating a comprehensive strategy for improving water quality in Kentucky's rivers and streams, it is useful to understand how land is used or missued. For example, in order to gain some insight into the impacts of non-point source pollutants on water quality, knowledge of existing and projected land use is useful.

Water quality may be affected by fertilizers and pesticides used on agricultural cropland and by timber operations in forests. Water quality may be affected by mining and quarrying and construction activity as agricultural land is converted to urban uses. In urban areas, stormwater runoff from rooftops, streets and other paved areas often carries pollutants which can cause significant water quality degration.

In gathering and developing land use information for use in the Kentucky River Basin study, it became readily apparent that the kinds of data we would like to have had were not available. For example, information on projected future land use in most categories was extremely limited and as extensive research and field investigations were beyond the scope of this study, our data base is less than ideal. However, it does represent an initial attempt at presenting a base from which preliminary water quality impacts can be derived. Additional research and improvement in data collection and land use projection techniques will be necessary before a full understanding of the relationships between land use and water quality is achieved. Methods for determining land use in each category were as follows:

Urbanized Areas

Area measurements for urbanized areas in the Kentucky River Basin were obtained by planimetering Kentucky Department of Highway Maps at 1:125,000 scale (1" = $\pm$ 2 miles). This information represented 1960 or 1970 urban area figures depending upon the date the map was prepared. A ratio was then established between land area and population for each of the urbanized areas within the basin. This ratio was then utilized to determine estimated area increases for each projection for each community with a projected population increase.

Rural Areas

Rural areas by county were determined by subtracting the urbanized area total from the county "in basin" area total.

Construction Related

"Construction related" area is tne difference between the sum of successive "at year or projected urban" and "rural nonfarm" areas.

Mining Related

Mining areas were derived from the Kentucky Department for Natural Resources and Environmental Protection, Division of Reclamation report entitled "Acreage Disturbed by Strip Mining 1954-1973". While it is recognized that this data is a less than adequate reflection of the situation with regard to mining activity in the Kentucky River Basin, concerted efforts to obtain more definitive trend data and information or projected future mining activity were unsuccessful; therefore, the 1970 figure was held constant through each projection period. However, a study currently being conducted by William G. Adams, a research director at Eastern Kentucky University, should effect a further understanding of the relationship between mining activity and water quality. Among the information being gathered is the location of pre-law mines (not presently being remined), active mines, reclaimed mines and the location of public roads being heavily utilized by coal trucks.

Agriculture and Silviculture

Total land area in agriculture and silviculture within each county and in turn within each segment was determined by utilizing three data sources including: (1) the Soil Conservation Service Document entitled Soil and Water Conservation Needs Inventory, 1970; (2) Soil Conservation Service soils suitability maps; (3) U.S.G.S. topographic maps.

SCS land use inventory data by county was used as control totals for agriculture and silviculture areas and the ratios between these two land uses by county were generally utilized in determining segment areas and modified when appropriate to conform with available mapped data.

As no information was available on projected future agriculture and silviculture, these areas were held constant through each projection period, except in the case when an urban or rural non-farm community was expected to increase in size. In these instances, the projected increases in area were subtracted from the agriculture area.

EXHIBIT A-6.1t presents land use areas by county for the thirty-nine counties within the Kentucky River Basin for 1970, 1980 and 1995 along with "between year" area and percentage changes. The "in basin" total is the sum of Agricultural area, Silviculture area, Mining Related and Urban area, (urban and rural non-farm). Detailed land use information by segment is presented in Appendix B.

Exhibit A-6.1t Land Use Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year or Projected Land Area (Sq.Mi.)				Between Year Number / % Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Thirty-Nine County Total	11,159.8	11,159.8	11,159.8	11,159.8	-	-	-
Out of Basin Area	4,088.1	4,088.1	4,088.1	4,088.1	-	-	-
In Ky.River Basin Area	7,071.7	7,071.7	7,071.7	7,071.7	-	-	-
Rural Area	6,970.7	6,961.9	6,950.9	6,913.3	-8.8 / -0.1%	-11.0 / -0.1%	-37.6 / -0.5%
Agriculture	3,322.7	3,313.9	3,302.9	3,265.3	-8.8 / -0.2%	-11.0 / -0.3%	-37.6 / -1.1%
Silviculture	3,637.4	3,637.4	3,637.4	3,637.4	-	-	-
Mining Related	10.6	10.6	10.6	10.6	-	-	-
Construction Related	-	8.8	11.0	37.6	-	2.2 / 25.0%	26.6 /242.0%
Urban Area	101.0	109.8	120.8	158.4	8.8 / 8.0%	11.0 / 10.0%	37.6 / 31.1%
Anderson County Area	206.0	206.0	206.0	206.0	-	-	-
Out of Basin Area	175.5	175.5	175.5	175.5	-	-	-
In Ky.River Basin Area	30.5	30.5	30.5	30.5	-	-	-
Rural Area	30.5	30.5	30.5	30.5	-	-	-
Agriculture	22.3	22.3	22.3	22.3	-	-	-
Silviculture	8.2	8.2	8.2	8.2	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Bell County Area	369.9	369.9	369.9	369.9	-	-	-
Out of Basin Area	356.9	356.9	356.9	356.9	-	-	-
In Ky.River Basin Area	13.0	13.0	13.0	13.0	-	-	-
Rural Area	13.0	13.0	13.0	13.0	-	-	-
Agriculture	1.1	1.1	1.1	1.1	-	-	-
Silviculture	11.8	11.8	11.8	11.8	-	-	-
Mining Related	0.1	0.1	0.1	0.1	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Boone County Area	249.3	249.3	249.3	249.3	-	-	-
Out of Basin Area	237.8	237.8	237.8	237.8	-	-	-
In Ky.River Basin Area	11.5	11.5	11.5	11.5	-	-	-
Rural Area	11.5	11.5	11.5	11.5	-	-	-
Agriculture	8.2	8.2	8.2	8.2	-	-	-
Silviculture	3.3	3.3	3.3	3.3	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Boyle County Area	183.3	183.3	183.3	183.3	-	-	-
Out of Basin Area	112.6	112.6	112.6	112.6	-	-	-
In Ky.River Basin Area	70.7	70.7	70.7	70.7	-	-	-
Rural Area	66.3	66.2	66.0	65.2	-0.1 / -0.1%	0.2 / -0.3%	-0.8 / -1.2%
Agriculture	54.0	53.9	53.7	52.9	-0.1 / -0.2%	-0.2 / -0.4%	-0.8 / 1.5%
Silviculture	12.3	12.3	12.3	12.3	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.1	0.2	0.8	-	0.1 / 50.0%	0.6 / 75.0%
Urban Area	4.4	4.5	4.7	5.5	0.1 / 2.2%	0.2 / 4.2%	0.8 / 14.5%
Breathitt County Area	494.0	494.0	494.0	494.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	494.0	494.0	494.0	494.0	-	-	-
Rural Area	492.8	492.8	492.8	492.8	-	-	-
Agriculture	117.6	117.6	117.6	117.6	-	-	-
Silviculture	374.0	374.0	374.0	374.0	-	-	-
Mining Related	1.2	1.2	1.2	1.2	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	1.2	1.2	1.2	1.2	-	-	-
Carroll County Area	130.0	130.0	130.0	130.0	-	-	-
Out of Basin Area	43.2	43.2	43.2	43.2	-	-	-
In Ky.River Basin Area	86.8	86.8	86.8	86.8	-	-	-
Rural Area	84.5	84.4	84.2	83.4	-0.1 / -0.1%	-0.2 / 0.2%	-0.8 / -1.0%
Agriculture	56.8	56.7	56.5	55.7	-0.1 / -0.2%	-0.2 / -0.3%	-0.8 / -1.4%
Silviculture	27.7	27.7	27.7	27.7	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.1	0.2	0.8	-	0.1 / 50.0%	0.6 / 75.0%
Urban Area	2.3	2.4	2.6	3.4	0.1 / 4.2%	0.2 / 7.7%	0.8 / 23.5%

Exhibit A-6.1t Land Use Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year or Projected Land Area(Sq.Mi.)				Between Year Number / % Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Casey County Area	435.0	435.0	435.0	435.0	-	-	-
Out of Basin Area	431.3	431.3	431.3	431.3	-	-	-
In Ky.River Basin Area	3.7	3.7	3.7	3.7	-	-	-
Rural Area	3.7	3.7	3.7	3.7	-	-	-
Agriculture	1.6	1.6	1.6	1.6	-	-	-
Silviculture	2.1	2.1	2.1	2.1	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Clark County Area	259.0	259.0	259.0	259.0	-	-	-
Out of Basin Area	109.4	109.4	109.4	109.4	-	-	-
In Ky.River Basin Area	149.6	149.6	149.6	149.6	-	-	-
Rural Area	149.6	149.6	149.6	149.6	-	-	-
Agriculture	137.6	137.6	137.6	137.6	-	-	-
Silviculture	12.0	12.0	12.0	12.0	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Clay County Area	474.0	474.0	474.0	474.0	-	-	-
Out of Basin Area	24.0	24.0	24.0	24.0	-	-	-
In Ky.River Basin Area	450.0	450.0	450.0	450.0	-	-	-
Rural Area	449.3	449.3	449.2	449.1	-	-0.1 / -0.02%	-0.1 / -0.02%
Agriculture	73.8	73.8	73.7	73.6	-	-0.1 / -0.1 %	-0.1 / -0.1 %
Silviculture	375.4	375.4	375.4	375.4	-	-	-
Mining Related	0.1	0.1	0.1	0.1	-	-	-
Construction Related	-	-	0.1	0.1	-	-	-
Urban Area	0.7	0.7	0.8	0.9	-	0.1 / 12.5 %	0.1 / 11.1 %
Estill County Area	260.0	260.0	260.0	260.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	260.0	260.0	260.0	260.0	-	-	-
Rural Area	258.4	258.3	258.1	257.6	-0.1 / -0.04%	-0.2 / -0.08%	-0.5 / -0.2 %
Agriculture	64.7	64.6	64.4	63.9	-0.1 / -0.1 %	-0.2 / -0.3 %	-0.5 / -0.8 %
Silviculture	193.7	193.7	193.7	193.7	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.1	0.2	0.5	-	0.1 / 50.0 %	0.3 / 60.0 %
Urban Area	1.6	1.7	1.9	2.4	0.1 / 5.9 %	0.2 / 10.5 %	0.5 / 20.8 %
Fayette County Area	280.2	280.2	280.2	280.2	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	280.2	280.2	280.2	280.2	-	-	-
Rural Area	249.1	244.9	241.0	226.9	-4.2 / -1.7 %	-3.9 / 1.6 %	-14.1 / -6.2 %
Agriculture	236.5	232.3	228.4	214.3	-4.2 / -1.8 %	-3.9 / 1.7 %	-14.1 / -6.6 %
Silviculture	12.6	12.6	12.6	12.6	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	4.2	3.9	14.1	-	-0.3 / -7.7 %	10.2 / 72.3 %
Urban Area	31.1	35.3	39.2	53.3	4.2 /	3.9 / 9.9 %	14.1 / 26.4 %
Franklin County Area	211.0	211.0	211.0	211.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin	211.0	211.0	211.0	211.0	-	-	-
Rural Area	204.2	203.3	202.2	198.1	-0.9 / -0.4 %	-1.1 / -0.5 %	-4.1 / -2.0 %
Agriculture	130.7	129.8	128.7	124.6	-0.9 / -0.7 %	-1.1 / -0.8 %	-4.1 / -3.3 %
Silviculture	73.5	73.5	73.5	73.5	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.9	1.1	4.1	-	0.2 / 18.2 %	3.0 / 73.2 %
Urban Area	6.8	7.7	8.8	12.9	0.9 / 11.7 %	1.1 / 12.5 %	4.1 / 31.8 %
Gallatin County Area	99.6	99.6	99.6	99.6	-	-	-
Out of Basin Area	77.6	77.6	77.6	77.6	-	-	-
In Ky.River Basin Area	22.0	22.0	22.0	22.0	-	-	-
Rural Area	21.4	21.4	21.3	21.2	-	-0.1 / -0.5 %	-0.1 / -0.5 %
Agriculture	14.5	14.5	14.4	14.3	-	-0.1 / -0.7 %	-0.1 / -0.7 %
Silviculture	6.9	6.9	6.9	6.9	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	0.1	0.1	-	-	-
Urban Area	0.6	0.6	0.7	0.8	-	0.1 / 14.3 %	0.1 / 12.5 %

Exhibit A-6.1t Land Use Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year or Projected Land Area(Sq.Mi.)				Between Year Number / % Change		
	1970	1975	1980	1995	1970-1975	1975-1980	1980-1995
Garrard County Area	236.4	236.4	236.4	236.4	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	236.4	236.4	236.4	236.4	-	-	-
Rural Area	235.1	235.1	235.0	234.7	-	-0.1 / -0.04%	-0.3 / -0.1 %
Agriculture	195.0	195.0	194.9	194.6	-	-0.1 / -0.05%	-0.3 / -0.1 %
Silviculture	40.1	40.1	40.1	40.1	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	0.1	0.1	-	-	0.2 / 66.7 %
Urban Area	1.3	1.3	1.4	1.7	-	0.1 / 7.1 %	0.3 / 17.6 %
Grant County Area	248.7	248.7	248.7	248.7	-	-	-
Out of Basin Area	79.4	79.4	79.4	79.4	-	-	-
In Ky.River Basin Area	169.3	169.3	169.3	169.3	-	-	-
Rural Area	160.2	159.7	159.1	156.9	-0.5 / -0.3 %	-0.6 / -0.4 %	-2.2 / -1.4 %
Agriculture	120.2	119.7	119.1	116.9	-0.5 / -0.4 %	-0.6 / -0.5 %	-2.2 / -1.9 %
Silviculture	40.0	40.0	40.0	40.0	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.5	0.6	2.2	-	0.1 / 16.7 %	1.6 / 72.7 %
Urban Area	9.1	9.6	10.2	12.4	0.5 / 5.2 %	0.6 / 5.9 %	2.2 / 17.7 %
Harlan County Area	468.1	468.1	468.1	468.1	-	-	-
Out of Basin Area	417.1	417.1	417.1	417.1	-	-	-
In Ky.River Basin Area	51.0	51.0	51.0	51.0	-	-	-
Rural Area	51.0	51.0	51.0	51.0	-	-	-
Agriculture	5.1	5.1	5.1	5.1	-	-	-
Silviculture	45.8	45.8	45.8	45.8	-	-	-
Mining Related	0.1	0.1	0.1	0.1	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Henry County Area	289.1	289.1	289.1	289.1	-	-	-
Out of Basin Area	24.1	24.1	24.1	24.1	-	-	-
In Ky.River Basin Area	265.0	265.0	265.0	265.0	-	-	-
Rural Area	264.4	264.4	264.4	264.3	-	-	-0.1 / -0.04%
Agriculture	199.4	199.4	199.4	199.3	-	-	-0.1 / -0.05%
Silviculture	65.0	65.0	65.0	65.0	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	-	0.1	-	-	-
Urban Area	0.6	0.6	0.6	0.7	-	-	0.1 / 14.3 %
Jackson County Area	337.0	337.0	337.0	337.0	-	-	-
Out of Basin Area	187.0	187.0	187.0	187.0	-	-	-
In Ky.River Basin Area	150.0	150.0	150.0	150.0	-	-	-
Rural Area	150.0	150.0	150.0	150.0	-	-	-
Agriculture	74.6	74.6	74.6	74.6	-	-	-
Silviculture	75.3	75.3	75.3	75.3	-	-	-
Mining Related	0.1	0.1	0.1	0.1	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Jessamine County Area	177.0	177.0	177.0	177.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	177.0	177.0	177.0	177.0	-	-	-
Rural Area	173.9	173.1	172.1	167.8	-0.8 / -0.4 %	-1.0 / -0.6 %	-4.3 / -2.5 %
Agriculture	153.1	152.3	151.3	147.0	-0.8 / -0.5 %	-1.0 / -0.7 %	-4.3 / -2.9 %
Silviculture	20.8	20.8	20.8	20.8	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.8	1.0	4.3	-	0.2 / 20.0 %	3.3 / 76.7 %
Urban Area	3.1	3.9	4.9	9.2	0.8 / 20.5 %	1.0 / 20.4 %	4.3 / 46.7 %
Knott County Area	356.0	356.0	356.0	356.0	-	-	-
Out of Basin Area	98.0	98.0	98.0	98.0	-	-	-
In Ky.River Basin Area	258.0	258.0	258.0	258.0	-	-	-
Rural Area	257.2	257.1	257.0	256.8	-0.1 / -0.04%	-0.1 / -0.04%	-0.2 / -0.08%
Agriculture	33.0	32.9	32.8	32.6	-0.1 / -0.3 %	-0.1 / -0.3 %	-0.2 / -0.6 %
Silviculture	223.1	223.1	223.1	223.1	-	-	-
Mining Related	1.1	1.1	1.1	1.1	-	-	-
Construction Related	-	0.1	0.1	0.2	-	-	0.1 / 50.0 %
Urban Area	0.8	0.9	1.0	1.2	0.1 / 11.1 %	0.1 / 10.0 %	0.2 / 16.7 %

Exhibit A-6.1t Land Use Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year or Projected Land Area(Sq.Mi.) 1970	1975	1980	1995	Between Year Number / % Change 1970-1975	1975-1980	1980-1995
Knox County Area	372.0	372.0	372.0	372.0	-	-	-
Out of Basin Area	335.5	335.5	335.5	335.5	-	-	-
In Ky.River Basin Area	36.5	36.5	36.5	36.5	-	-	-
Rural Area	36.5	36.5	36.5	36.5	-	-	-
Agriculture	8.7	8.7	8.7	8.7	-	-	-
Silviculture	27.7	27.7	27.7	27.7	-	-	-
Mining Related	0.1	0.1	0.1	0.1	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Lee County Area	210.0	210.0	210.0	210.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	210.0	210.0	210.0	210.0	-	-	-
Rural Area	209.0	209.0	209.0	209.0	-	-	-
Agriculture	37.7	37.7	37.7	37.7	-	-	-
Silviculture	171.3	171.3	171.3	171.3	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Related	1.0	1.0	1.0	1.0	-	-	-
Leslie County Area	412.0	412.0	412.0	412.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	412.0	412.0	412.0	412.0	-	-	-
Rural Area	411.2	411.1	411.0	410.3	-0.1 / -0.02%	-0.1 / -0.02%	-0.7 / -0.2 %
Agriculture	49.3	49.2	49.1	48.4	-0.1 / -0.2 %	-0.1 / -0.2 %	-0.7 / -1.4 %
Silviculture	361.0	361.0	361.0	361.0	-	-	-
Mining Related	0.9	0.9	0.9	0.9	-	-	-
Construction Related	-	0.1	0.1	0.7	-	-	0.6 / 85.7 %
Urban Area	0.8	0.9	1.0	1.7	0.1 / 11.1 %	0.1 / 10.0 %	0.7 / 41.2 %
Letcher County Area	339.0	339.0	339.0	339.0	-	-	-
Out of Basin Area	66.4	66.4	66.4	66.4	-	-	-
In Ky.River Basin Area	272.6	272.6	272.6	272.6	-	-	-
Rural Area	268.1	268.1	268.1	268.1	-	-	-
Agriculture	24.9	24.9	24.9	24.9	-	-	-
Silviculture	240.8	240.8	240.8	240.8	-	-	-
Mining Related	2.4	2.4	2.4	2.4	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	4.5	4.5	4.5	4.5	-	-	-
Lincoln County Area	340.0	340.0	340.0	340.0	-	-	-
Out of Basin Area	141.0	141.0	141.0	141.0	-	-	-
In Ky.River Basin Area	199.0	199.0	199.0	199.0	-	-	-
Rural Area	193.5	193.4	193.2	192.3	-0.1 / -0.05%	-0.2 / -0.1 %	-0.9 / -0.5 %
Agriculture	139.8	139.7	139.5	138.6	-0.1 / -0.07%	-0.2 / -0.1 %	-0.9 / -0.6 %
Silviculture	53.7	53.7	53.7	53.7	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.1	0.2	0.9	-	0.1 / 50.0 %	0.7 / 77.8 %
Urban Area	5.5	5.6	5.8	6.7	0.1 / 1.8 %	0.2 / 3.4 %	0.9 / 13.4 %
Madison County Area	445.6	445.6	445.6	445.6	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	445.6	445.6	445.6	445.6	-	-	-
Rural Area	438.7	437.8	436.7	432.7	-0.9 / -0.2 %	-1.1 / -0.2 %	-4.0 / -0.9 %
Agriculture	335.7	334.8	333.7	329.7	-0.9 / -0.3 %	-1.1 / -0.3 %	-4.0 / -1.2 %
Silviculture	103.0	103.0	103.0	103.0	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.9	1.1	4.0	-	0.2 / 18.2 %	2.9 / 72.5 %
Urban Area	6.9	7.8	8.9	12.9	0.9 / 11.5 %	1.1 / 12.3 %	4.0 / 31.0 %
Menifee County Area	210.0	210.0	210.0	210.0	-	-	-
Out of Basin Area	131.5	131.5	131.5	131.5	-	-	-
In Ky.River Basin Area	78.5	78.5	78.5	78.5	-	-	-
Rural Area	78.5	78.5	78.5	78.5	-	-	-
Agriculture	14.2	14.2	14.2	14.2	-	-	-
Silviculture	64.3	64.3	64.3	64.3	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-

Exhibit A-6.1t Land Use Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year or Projected Land Area(Sq.Mi.) 1970	1975	1980	1995	Between Year Number / % Change 1970-1975	1975-1980	1980-1995
Mercer County Area	255.6	255.6	255.6	255.6	-	-	-
Out of Basin Area	165.6	165.6	165.6	165.6	-	-	-
In Ky.River Basin Area	90.0	90.0	90.0	90.0	-	-	-
Rural Area	89.4	89.4	89.3	89.2	-	-0.1 / -0.1 %	-0.1 / -0.1 %
Agriculture	78.8	78.8	78.7	78.6	-	-0.1 / -0.1 %	-0.1 / -0.1 %
Silviculture	10.6	10.6	10.6	10.6	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	0.1	0.1	-	-	-
Urban Area	0.6	0.6	0.7	0.8	-	0.1 / 14.3 %	0.1 / 12.5 %
Montgomery County Area	204.0	204.0	204.0	204.0	-	-	-
Out of Basin Area	178.5	178.5	178.5	178.5	-	-	-
In Ky.River Basin Area	25.5	25.5	25.5	25.5	-	-	-
Rural Area	25.5	25.5	25.5	25.5	-	-	-
Agriculture	21.7	21.7	21.7	21.7	-	-	-
Silviculture	3.8	3.8	3.8	3.8	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Owen County Area	351.0	351.0	351.0	351.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	351.0	351.0	351.0	351.0	-	-	-
Rural Area	348.6	348.6	348.5	348.3	-	-0.1 / -0.03%	-0.2 / -0.05%
Agriculture	221.6	221.6	221.5	221.3	-	-0.1 / -0.04%	-0.2 / -0.09%
Silviculture	127.0	127.0	127.0	127.0	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	0.1	0.2	-	-	0.1 / 50.0 %
Urban Area	2.4	2.4	2.5	2.7	-	0.1 / 4.0 %	0.2 / 7.4 %
Owsley County Area	197.0	197.0	197.0	197.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	197.0	197.0	197.0	197.0	-	-	-
Rural Area	196.9	196.9	196.9	196.9	-	-	-
Agriculture	44.2	44.2	44.2	44.2	-	-	-
Silviculture	152.6	152.6	152.6	152.6	-	-	-
Mining Related	0.1	0.1	0.1	0.1	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	0.1	0.1	0.1	0.1	-	-	-
Perry County Area	343.0	343.0	343.0	343.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	343.0	343.0	343.0	343.0	-	-	-
Rural Area	339.6	339.6	339.6	339.6	-	-	-
Agriculture	41.1	41.1	41.1	41.1	-	-	-
Silviculture	294.3	294.3	294.3	294.3	-	-	-
Mining Related	4.2	4.2	4.2	4.2	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	3.4	3.4	3.4	3.4	-	-	-
Powell County Area	173.0	173.0	173.0	173.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	173.0	173.0	173.0	173.0	-	-	-
Rural Area	169.1	168.6	167.6	165.7	-0.5 / 0.3 %	-1.0 / -0.6 %	-1.9 / -1.1 %
Agriculture	40.6	40.1	39.1	37.2	-0.5 / 1.2 %	-1.0 / -2.5 %	-1.9 / -5.1 %
Silviculture	128.5	128.5	128.5	128.5	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.5	1.0	1.9	-	0.5 / 50.0 %	0.9 / 47.4 %
Urban Area	3.9	4.4	5.4	7.3	0.5 / 11.3 %	1.0 / 18.5 %	1.9 / 26.0 %
Rockcastle County Area	311.0	311.0	311.0	311.0	-	-	-
Out of Basin Area	274.0	274.0	274.0	274.0	-	-	-
In Ky.River Basin Area	37.0	37.0	37.0	37.0	-	-	-
Rural Area	35.8	35.8	35.8	35.8	-	-	-
Agriculture	10.2	10.2	10.2	10.2	-	-	-
Silviculture	25.5	25.5	25.5	25.5	-	-	-
Mining Related	0.1	0.1	0.1	0.1	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	1.2	1.2	1.2	1.2	-	-	-

Exhibit A-6.1t Land Use Trends and Projections, 1970-1995 For The Kentucky River Basin

Area of Coverage	At Year or Projected Land Area(Sq.Mi.) 1970	1975	1980	1995	Between Year Number / % Change 1970-1975	1975-1980	1980-1995
Scott County Area	284.0	284.0	284.0	284.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	284.0	284.0	284.0	284.0	-	-	-
Rural Area	281.0	280.9	280.7	280.2	-0.1 / -0.03%	-0.2 / -0.07%	-0.5 / -0.2 %
Agriculture	239.6	239.5	239.3	238.8	-0.1 / -0.04%	-0.2 / -0.08%	-0.5 / -0.2 %
Silviculture	41.4	41.4	41.4	41.4	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.1	0.2	0.5	-	-	-
Urban Area	3.0	3.1	3.3	3.8	0.1 / 3.2 %	0.2 / 6.0 %	0.5 / 13.1 %
Shelby County Area	383.0	383.0	383.0	383.0	-	-	-
Out of Basin Area	322.7	322.7	322.7	322.7	-	-	-
In Ky.River Basin Area	60.3	60.3	60.3	60.3	-	-	-
Rural Area	60.3	60.3	60.3	60.3	-	-	-
Agriculture	51.9	51.9	51.9	51.9	-	-	-
Silviculture	8.4	8.4	8.4	8.4	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	-	-	-	-	-
Urban Area	-	-	-	-	-	-	-
Trimble County Area	146.0	146.0	146.0	146.0	-	-	-
Out of Basin Area	99.0	99.0	99.0	99.0	-	-	-
In Ky.River Basin Area	47.0	47.0	47.0	47.0	-	-	-
Rural Area	46.8	46.8	46.7	46.7	-	-0.1 / -0.2 %	-
Agriculture	29.3	29.3	29.2	29.2	-	-0.1 / -0.3 %	-
Silviculture	17.5	17.5	17.5	17.5	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	-	0.1	-	-	-	-
Urban Area	0.2	0.2	0.3	0.3	-	0.1 / 33.3 %	-
Wolfe County Area	227.0	227.0	227.0	227.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	227.0	227.0	227.0	227.0	-	-	-
Rural Area	226.1	226.1	226.0	225.7	-	-0.1 / -0.04%	-0.3 / -0.1 %
Agriculture	58.9	58.9	58.8	58.5	-	-0.1 / -0.2 %	-0.3 / -0.5 %
Silviculture	167.1	167.1	167.1	167.1	-	-	-
Mining Related	0.1	0.1	0.1	0.1	-	-	-
Construction Related	-	-	0.1	0.3	-	-	0.2 / 66.7 %
Urban Area	0.9	0.9	1.0	1.3	-	0.1 / 10.0 %	0.3 / 23.1 %
Woodford County Area	193.0	193.0	193.0	193.0	-	-	-
Out of Basin Area	-	-	-	-	-	-	-
In Ky.River Basin Area	193.0	193.0	193.0	193.0	-	-	-
Rural Area	190.0	189.7	189.3	187.9	-0.3 / -0.1 %	-0.4 / -0.2 %	-1.4 / -0.7 %
Agriculture	174.7	174.4	174.0	172.6	-0.3 / -0.1 %	-0.4 / -0.2 %	-1.4 / -0.8 %
Silviculture	15.3	15.3	15.3	15.3	-	-	-
Mining Related	-	-	-	-	-	-	-
Construction Related	-	0.3	0.4	1.4	-	0.1 / 25.0 %	1.0 / 71.4 %
Urban Area	3.0	3.3	3.7	5.1	0.3 / 9.1 %	0.4 / 10.8 %	1.4 / 27.4 %

SURFACE AREA DISAGGREGATION

Introduction

In order to determine the surface area within the Kentucky River Basin and within each of its fifty-nine segments, figures from the U.S. Census "Area Measurement Report, 1970" were used as controls and "in basin" and "out of basin" areas by county and individual segment areas were planimetered utilizing U.S. Army Map Service Maps at 1:250,000 scale (1" = ± 4 miles).

The surface area measurements for each county and the disaggregation to the Kentucky River Basin are presented in EXHIBIT A-7.1t.

EXHIBIT A-7.2t presents the surface area within the Kentucky River Basin which lies within each county, the percent of Kentucky, the percent of the Kentucky River Basin ,and, the percent of each county. In each case, total surface area figures are used.

Exhibit A-7.1t Surface Area Breakdown For KYRB

County Breakdown	Total Surface Area Acres*	Total Surface Area Sq.Mi.	% of Total*
Thirty-Nine County Total	7,169,920	11,203	100
Outside Ky.River Basin	2,639,232	4,123.8	37
Inside Ky. River Basin	4,530,688	7,079.2	63
Anderson County	131,840	206.0	100
Outside Ky.River Basin	112,320	175.5	85
Inside Ky. River Basin	19,520	30.5	15
Bell County	236,800	370.0	100
Outside Ky.River Basin	228,480	357.0	96
Inside Ky. River Basin	8,320	13.0	4
Boone County	166,400	260.0	100
Outside Ky.River Basin	159,040	248.0	96
Inside Ky. River Basin	7,360	11.5	4
Boyle County	117,760	184.0	100
Outside Ky.River Basin	725,512	113.3	62
Inside Ky. River Basin	45,248	70.7	38
Breathitt County	316,160	494.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	316,160	494.0	100
Carroll County	88,320	138.0	100
Outside Ky.River Basin	32,768	51.2	37
Inside Ky. River Basin	55,552	86.8	63
Casey County	278,400	435.0	100
Outside Ky.River Basin	276,032	431.3	92
Inside Ky. River Basin	2,368	3.7	8
Clark County	165,760	259.0	100
Outside Ky.River Basin	70,016	109.4	42
Inside Ky. River Basin	95,744	149.6	58
Clay County	303,360	474.0	100
Outside Ky.River Basin	15,360	24.0	5
Inside Ky. River Basin	288,000	450.0	95
Estill County	166,400	260.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	166,400	260.0	100
Fayette County	179,840	281.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	179,840	281.0	100

Exhibit A-7.1t Surface Area Breakdown For KYRB

County Breakdown	Total Surface Area Acres*	Total Surface Area Sq.Mi.	% of Total*
Franklin County	135,040	211.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	135,040	211.0	100
Gallatin County	67,200	105.0	100
Outside Ky.River Basin	53,120	83.0	79
Inside Ky. River Basin	14,080	22.0	21
Garrard County	152,320	238.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	152,320	238.0	100
Grant County	160,000	250.0	100
Outside Ky.River Basin	50,816	79.4	32
Inside Ky. River Basin	109,184	170.6	68
Harlan County	300,160	469.0	100
Outside Ky.River Basin	267,520	418.0	89
Inside Ky. River Basin	32,640	51.0	11
Henry County	184,960	289.0	100
Outside Ky.River Basin	15,360	24.0	8
Inside Ky. River Basin	169,600	265.0	92
Jackson County	215,680	337.0	100
Outside Ky.River Basin	119,680	187.0	55
Inside Ky. River Basin	96,000	150.0	45
Jessamine County	113,280	177.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	113,280	177.0	100
Knott County	227,840	356.0	100
Outside Ky.River Basin	62,720	98.0	28
Inside Ky. River Basin	165,120	258.0	72
Knox County	238,720	373.0	100
Outside Ky.River Basin	215,360	336.5	90
Inside Ky. River Basin	23,360	36.5	10
Lee County	134,400	210.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	134,400	210.0	100
Leslie County	263,680	412.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	263,680	412.0	100

Exhibit A-7.1t Surface Area Breakdown For KYRB

County Breakdown	Total Surface Area Acres*	Total Surface Area Sq.Mi.	% of Total*
Letcher County	216,960	339.0	100
Outside Ky.River Basin	42,496	66.4	20
Inside Ky. River Basin	174,464	272.6	80
Lincoln County	217,600	340.0	100
Outside Ky.River Basin	90,240	141.0	41
Inside Ky. River Basin	127,360	199.0	59
Madison County	285,440	446.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	285,440	446.0	100
Menifee County	134,400	210.0	100
Outside Ky.River Basin	84,160	131.5	63
Inside Ky. River Basin	50,240	78.5	37
Mercer County	165,760	259.0	100
Outside Ky.River Basin	105,984	165.6	64
Inside Ky. River Basin	59,776	93.4	36
Montgomery County	130,560	204.0	100
Outside Ky.River Basin	114,240	178.5	88
Inside Ky. River Basin	16,320	25.5	12
Owen County	224,640	351.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	224,640	351.0	100
Owsley County	126,080	197.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	126,080	197.0	100

Exhibit A-7.1t Surface Area Breakdown For KYRB

County Breakdown	Total Surface Area Acres*	Total Surface Area Sq.Mi.	% of Total*
Perry County	219,520	343.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	219.520	343.0	100
Powell County	110,720	173.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	110,720	173.0	100
Rockcastle County	199,040	311.0	100
Outside Ky.River Basin	175,360	274.0	88
Inside Ky. River Basin	23,680	37.0	12
Scott County	181,760	284.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	181,760	284.0	100
Shelby County	245,760	384.0	100
Outside Ky.River Basin	207,168	323.7	84
Inside Ky. River Basin	38,592	60.3	16
Trimble County	98,560	154.0	100
Outside Ky.River Basin	68,480	107.0	69
Inside Ky. River Basin	30,080	47.0	31
Wolfe County	145,280	227.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	145,280	227.0	100
Woodford County	123,520	193.0	100
Outside Ky.River Basin	-	-	-
Inside Ky. River Basin	123,520	193.0	100

Exhibit A-7.2t Surface Area By County Within The Kentucky River Basin

County Breakdown	Surface Area Acreage	Surface Area Sq. Miles	% of Kentucky	% of Kentucky River Basin	% of Each County
State of Kentucky	25,852,800	40,395	100	-	-
Thirty-Nine County Total	7,169,920	11,203	28	-	-
Outside Kentucky River Basin	2,639,232	4,123.8	10	-	-
Inside Kentucky River Basin	4,530,688	7,079.2	18	100	-
Anderson County Total	131,840	206.0	0.50	-	100
Outside Kentucky River Basin	112,320	175.5	0.43	-	85
Inside Kentucky River Basin	19,520	30.5	0.07	0.43	15
#13 Segment	11,840	18.5	0.04	0.26	9
#14 Segment	7,680	12.0	0.03	0.17	6
Bell County Total	236,800	370.0	0.92	-	100
Outside Kentucky River Basin	228,480	357.0	0.88	-	96
Inside Kentucky River Basin	8,320	13.0	0.04	0.19	4
#52 Segment	8,320	13.0	0.04	0.19	4
Boone County Total	166,400	260.0	0.64	-	100
Outside Kentucky River Basin	159,040	248.5	0.61	-	96
Inside Kentucky River Basin	7,360	11.5	0.03	0.16	4
#8 Segment	7,360	11.5	0.03	0.16	4
Boyle County Total	117,760	184.0	0.46	-	100
Outside Kentucky River Basin	72,512	113.3	0.28	-	62
Inside Kentucky River Basin	45,248	70.7	0.18	1.00	38
#30 Segment	17,216	26.9	0.07	0.38	15
#31 Segment	18,432	28.8	0.07	0.41	16
#32 Segment	9,600	15.0	0.04	0.21	7

Exhibit A-7.2t

Surface Area By County Within The Kentucky River Basin

County Breakdown	Surface Area		% of Kentucky	% of Kentucky River Basin	% of Each County
	Acreage	Sq. Miles			
Breathitt County Total	316,160	494.0	1.22	6.98	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	316,160	494.0	1.22	6.98	100
#45 Segment	73,600	115.0	0.28	1.62	23
#47 Segment	70,464	108.9	0.27	1.54	22
#48 Segment	33,664	53.8	0.13	0.76	11
#49 Segment	94,144	147.1	0.36	2.08	30
#50 Segment	44,288	69.2	0.18	0.98	14
Carroll County Total	88,320	138.0	0.34	-	100
Outside Kentucky River Basin	32,768	51.2	0.13	-	37
Inside Kentucky River Basin	55,552	86.8	0.21	1.23	63
#1 Segment	9,792	15.3	0.04	0.22	11
#2 Segment	7,680	12.0	0.03	0.17	9
#3 Segment	23,744	37.1	0.09	0.52	27
#7 Segment	14,336	22.4	0.05	0.32	16
Casey County Total	278,400	435.0	1.08	-	100
Outside Kentucky River Basin	276,032	431.3	1.07	-	92
Inside Kentucky River Basin	2,368	3.7	0.01	0.05	8
#32 Segment	2,368	3.7	0.01	0.05	8
Clark County Total	165,760	259.0	0.64	-	100
Outside Kentucky River Basin	70,016	109.4	0.27	-	42
Inside Kentucky River Basin	95,744	149.6	0.37	2.11	58
#22 Segment	17,024	26.6	0.07	0.38	10
#23 Segment	60,416	94.4	0.23	1.33	36
#26 Segment	7,360	11.5	0.03	0.16	5
#40 Segment	10,944	17.1	0.04	0.24	7
Clay County Total	303,360	474.0	1.17	-	100
Outside Kentucky River Basin	15,360	24.0	0.06	-	5
Inside Kentucky River Basin	288,000	450.0	1.11	6.36	95
#44 Segment	81,152	126.8	0.31	1.79	27
#51 Segment	151,104	236.1	0.58	3.34	50
#52 Segment	55,744	87.1	0.22	1.23	18
Estill County Total	166,400	260.0	0.64	3.67	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	166,400	260.0	0.64	3.67	100
#24 Segment	6,272	9.8	0.02	0.14	4
#36 Segment	91,008	142.2	0.35	2.01	55
#37 Segment	47,232	73.8	0.18	1.04	28
#40 Segment	21,888	34.2	0.08	0.48	13
Fayette County Total	179,840	281.0	0.69	3.97	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	179,840	281.0	0.69	3.97	100
#16 Segment	58,304	91.1	0.22	1.29	32
#17 Segment	45,120	70.5	0.17	1.00	25
#18 Segment	13,696	21.4	0.05	0.30	8
#21 Segment	1,152	1.8	0.01	0.03	1
#22 Segment	11,072	17.3	0.04	0.24	6
#25 Segment	29,184	45.6	0.12	0.64	16
#26 Segment	21,312	33.3	0.08	0.47	12
Franklin County Total	135,040	211.0	0.52	2.98	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	135,040	211.0	0.52	2.98	100
#5 Segment	4,608	7.2	0.02	0.10	3
#6 Segment	19,904	31.1	0.08	0.44	15
#12 Segment	18,560	29.0	0.07	0.41	14
#13 Segment	51,392	80.3	0.20	1.13	38
#15 Segment	24,256	37.9	0.09	0.54	18
#16 Segment	7,360	11.5	0.03	0.16	5
#17 Segment	8,960	14.0	0.03	0.20	7

Exhibit A-7.2t

Surface Area By County Within The Kentucky River Basin

County Breakdown	Surface Area		% of Kentucky	% of Kentucky River Basin	% of Each County
	Acreage	Sq. Miles			
Gallatin County Total	67,200	105.0	0.26	-	100
Outside Kentucky River Basin	53,120	83.0	0.21	-	79
Inside Kentucky River Basin	14,080	22.0	0.05	0.51	21
#7 Segment	12,096	18.9	0.04	0.27	18
#8 Segment	1,984	3.1	0.01	0.04	3
Garrard County Total	152,320	238.0	0.59	3.36	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	152,320	238.0	0.59	3.36	100
#20 Segment	13,952	21.8	0.05	0.31	9
#21 Segment	29,440	46.0	0.11	0.65	19
#29 Segment	1,088	1.7	0.01	0.02	1
#30 Segment	14,784	23.1	0.06	0.33	10
#32 Segment	24,128	37.7	0.09	0.53	16
#33 Segment	25,856	40.4	0.10	0.57	17
#34 Segment	43,072	67.3	0.17	0.95	28
Grant County Total	160,000	250.0	0.62	-	100
Outside Kentucky River Basin	50,816	79.4	0.20	-	32
Inside Kentucky River Basin	109,184	170.6	0.42	2.41	68
#7 Segment	16,000	25.0	0.06	0.35	10
#8 Segment	37,312	58.3	0.14	0.82	23
#9 Segment	20,672	32.3	0.08	0.46	13
#10 Segment	30,400	47.5	0.12	0.87	19
#11 Segment	4,800	7.5	0.02	0.11	3
Harlan County Total	300,160	469.0	1.16	-	100
Outside Kentucky River Basin	267,520	418.0	1.03	-	89
Inside Kentucky River Basin	32,640	51.0	0.13	0.72	11
#54 Segment	32,640	51.0	0.13	0.72	11
Henry County Total	184,960	289.0	0.72	-	100
Outside Kentucky River Basin	15,360	24.0	0.06	-	8
Inside Kentucky River Basin	169,600	265.0	0.66	3.74	92
#1 Segment	41,216	64.4	0.16	0.91	22
#3 Segment	12,800	20.0	0.05	0.28	7
#4 Segment	70,848	110.7	0.27	1.56	38
#5 Segment	40,448	63.2	0.16	0.89	22
#6 Segment	4,288	6.7	0.02	0.10	3
Jackson County Total	215,680	337.0	0.83	-	100
Outside Kentucky River Basin	119,680	187.0	0.46	-	55
Inside Kentucky River Basin	96,000	150.0	0.37	2.12	45
#36 Segment	64,576	100.9	0.25	1.43	30
#38 Segment	24,128	37.7	0.09	0.53	11
#44 Segment	7,296	11.4	0.03	0.16	9
Jessamine County Total	113,280	177.0	0.44	2.50	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	113,280	177.0	0.44	2.50	100
#14 Segment	17,600	27.5	0.07	0.39	16
#17 Segment	7,360	11.5	0.03	0.16	6
#19 Segment	4,480	7.0	0.02	0.10	4
#20 Segment	37,248	58.2	0.14	0.82	33
#21 Segment	14,520	22.7	0.06	0.32	13
#25 Segment	32,064	50.1	0.12	0.71	28
Knott County Total	227,840	356.0	0.88	-	100
Outside Kentucky River Basin	62,720	98.0	0.24	-	28
Inside Kentucky River Basin	165,120	258.0	0.64	3.64	72
#41 Segment	12,672	19.8	0.05	0.29	6
#49 Segment	33,664	52.6	0.13	0.74	15
#50 Segment	77,056	120.4	0.30	1.70	34
#56 Segment	2,880	4.5	0.01	0.06	1
#57 Segment	16,512	25.8	0.06	0.36	7
#58 Segment	22,336	34.9	0.09	0.49	9

Exhibit A-7.2t

Surface Area By County Within The Kentucky River Basin

County Breakdown	Surface Area		% of Kentucky	% of Kentucky River Basin	% of Each County
	Acreage	Sq. Miles			
Knox County Total	238,720	373.0	0.92	-	100
Outside Kentucky River Basin	215,360	336.5	0.83	-	90
Inside Kentucky River Basin	23,360	36.5	0.09	0.52	10
#51 Segment	23,360	36.5	0.09	0.52	10
Lee County Total	134,400	210.0	0.52	1.02	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	134,400	210.0	0.52	1.02	100
#37 Segment	25,856	40.4	0.10	0.57	19
#38 Segment	28,288	44.2	0.11	0.62	21
#39 Segment	19,328	30.2	0.07	0.43	14
#44 Segment	6,400	10.0	0.03	0.02	5
#45 Segment	20,928	32.7	0.08	0.08	16
#47 Segment	33,600	52.5	0.13	0.13	25
Leslie County Total	263,680	412.0	1.02	5.82	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	263,680	412.0	1.02	5.82	100
#46 Segment	11,072	17.3	0.04	0.24	4
#52 Segment	55,168	86.2	0.21	1.22	21
#53 Segment	72,704	113.6	0.28	1.61	28
#54 Segment	124,736	194.9	0.48	2.75	47
Letcher County Total	216,960	339.0	0.84	-	100
Outside Kentucky River Basin	42,496	66.4	0.16	-	20
Inside Kentucky River Basin	174,464	272.6	0.68	3.85	80
#55 Segment	54,912	85.8	0.21	1.21	25
#59 Segment	119,552	186.8	0.46	2.64	55
Lincoln County Total	217,600	340.0	0.84	-	100
Outside Kentucky River Basin	90,240	141.0	0.35	-	41
Inside Kentucky River Basin	127,360	199.0	0.49	2.81	59
#32 Segment	58,368	91.2	0.23	1.29	27
#33 Segment	68,992	107.8	0.27	1.52	32
Madison County Total	285,440	446.0	1.10	6.30	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	285,440	446.0	1.10	6.30	100
#21 Segment	5,952	9.3	0.03	0.13	2
#22 Segment	15,104	23.6	0.06	0.33	5
#23 Segment	51,072	79.8	0.20	1.13	18
#24 Segment	4,160	6.5	0.02	0.09	1
#27 Segment	20,160	31.5	0.08	0.45	7
#28 Segment	33,792	52.8	0.13	0.75	12
#34 Segment	24,256	37.9	0.09	0.54	9
#35 Segment	66,816	104.4	0.26	1.47	23
#36 Segment	64,128	100.2	0.25	1.41	23
Menifee County Total	134,400	210.0	0.52	-	100
Outside Kentucky River Basin	84,160	131.5	0.33	-	63
Inside Kentucky River Basin	50,240	78.5	0.19	1.11	37
#41 Segment	1,152	1.8	0.01	0.02	1
#42 Segment	44,992	70.3	0.16	0.10	33
#43 Segment	4,096	6.4	0.02	0.09	3
Mercer County Total	165,760	259.0	0.64	-	100
Outside Kentucky River Basin	105,984	165.6	0.41	-	64
Inside Kentucky River Basin	59,776	93.4	0.23	1.32	36
#14 Segment	1,536	2.4	0.01	0.03	1
#19 Segment	34,368	53.7	0.13	0.76	20.6
#20 Segment	5,312	8.3	0.02	0.12	3
#29 Segment	704	1.1	0.01	0.02	0.4
#30 Segment	17,856	27.9	0.06	0.39	11
Montgomery County Total	130,560	204.0	0.50	-	100
Outside Kentucky River Basin	114,240	178.5	0.44	-	88
Inside Kentucky River Basin	16,320	25.5	0.06	0.36	12
#40 Segment	16,320	25.5	0.06	0.36	12

Exhibit A-7.2t

Surface Area By County Within The Kentucky River Basin

County Breakdown	Surface Area		% of Kentucky	% of Kentucky River Basin	% of Each County
	Acreage	Sq. Miles			
Owen County Total	224,640	351.0	0.87	4.96	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	224,640	351.0	0.87	4.96	100
#4 Segment	44,096	68.9	0.17	0.97	20
#5 Segment	65,984	103.1	0.26	1.46	29
#6 Segment	5,632	8.8	0.02	0.13	3
#7 Segment	35,072	54.8	0.14	0.77	16
#10 Segment	59,456	92.9	0.23	1.31	26
#11 Segment	14,400	22.5	0.05	0.32	6
Owsley County Total	126,080	197.0	0.49	2.78	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	126,080	197.0	0.49	2.78	100
#38 Segment	29,184	45.6	0.11	0.64	23
#44 Segment	95,232	148.8	0.37	2.10	76
#45 Segment	1,664	2.6	0.01	0.04	1
Perry County Total	219,520	343.0	0.85	4.85	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	219,520	343.0	0.85	4.85	100
#45 Segment	11,392	17.8	0.04	0.25	5
#46 Segment	14,848	23.2	0.06	0.33	7
#48 Segment	78,912	123.3	0.31	1.74	36
#50 Segment	34,752	54.3	0.13	0.77	16
#55 Segment	68,224	106.6	0.27	1.51	31
#56 Segment	11,392	17.8	0.04	0.25	5
Powell County Total	110,720	173.0	0.43	2.44	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	110,720	173.0	0.43	2.44	100
#40 Segment	31,616	49.4	0.13	0.70	29
#41 Segment	41,984	65.6	0.16	0.93	38
#42 Segment	37,120	58.0	0.14	0.81	33
Rockcastle County Total	199,040	311.0	0.77	-	100
Outside Kentucky River Basin	175,360	274.0	0.68	-	88
Inside Kentucky River Basin	23,680	37.0	0.09	0.52	12
#33 Segment	23,680	37.0	0.09	0.52	12
Scott County Total	181,760	284.0	0.70	4.01	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	181,760	284.0	0.70	4.01	100
#5 Segment	3,456	5.4	0.01	0.08	2
#10 Segment	69,952	109.3	0.27	1.54	38
#16 Segment	81,536	127.4	0.32	1.80	45
#17 Segment	15,552	24.3	0.06	0.34	9
#18 Segment	11,264	17.6	0.04	0.25	6
Shelby County Total	245,760	384.0	0.95	-	100
Outside Kentucky River Basin	207,168	323.7	0.80	-	84
Inside Kentucky River Basin	38,592	60.3	0.15	0.85	16
#5 Segment	20,352	31.8	0.08	0.45	8
#13 Segment	18,240	28.5	0.07	0.40	8
Trimble County Total	98,560	154.0	0.38	-	100
Outside Kentucky River Basin	68,480	107.0	0.26	-	69
Inside Kentucky River Basin	30,080	47.0	0.12	0.66	31
#1 Segment	29,760	46.5	0.11	0.65	30
#3 Segment	320	0.5	0.01	0.01	1
Wolfe County Total	145,280	227.0	0.56	3.21	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	145,280	227.0	0.56	3.21	100
#42 Segment	16,960	26.5	0.07	0.38	12
#43 Segment	88,960	139.0	0.34	1.96	61
#47 Segment	39,360	61.5	0.15	0.87	27

Exhibit A-7.2t

Surface Area By County Within The Kentucky River Basin

County Breakdown	Surface Area		% of Kentucky	% of Kentucky River Basin	% of Each County
	Acreage	Sq. Miles			
Woodford County Total	123,520	193.0	0.48	2.73	100
Outside Kentucky River Basin	-	-	-	-	-
Inside Kentucky River Basin	123,520	193.0	0.48	2.73	100
#13 Segment	26,560	41.5	0.10	0.59	22
#14 Segment	48,000	75.0	0.19	1.06	39
#17 Segment	40,000	62.5	0.15	0.88	32
#19 Segment	8,960	14.0	0.04	0.20	7

KENTUCKY RIVER BASIN

EXHIBIT B-1m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE —— MAJOR		PRINCIPAL
DOMESTIC	M 100	M 100
MUNICIPAL	M 100	M 100
INDUSTRIAL	I 100	I 100
COOLING WATER	C 100	C 100

- C.S. COMBINED SEWER AREA
- MINING OR QUARRYING ACTIVITY
- ACID MINE DRAINAGE
  - SIGNIFICANT AFFECT
  - INTERMITTENT AFFECT
- OIL RELATED
- LANDFILLS, DUMPS, JUNKYARDS
- LUMBER OPERATIONS
- SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS
- WATER QUALITY MONITORING
  - PRIMARY STATIONS
  - SECONDARY STATIONS

5 0 5

GRAPHIC SCALE IN MILES

Base Data: U S Geological Survey

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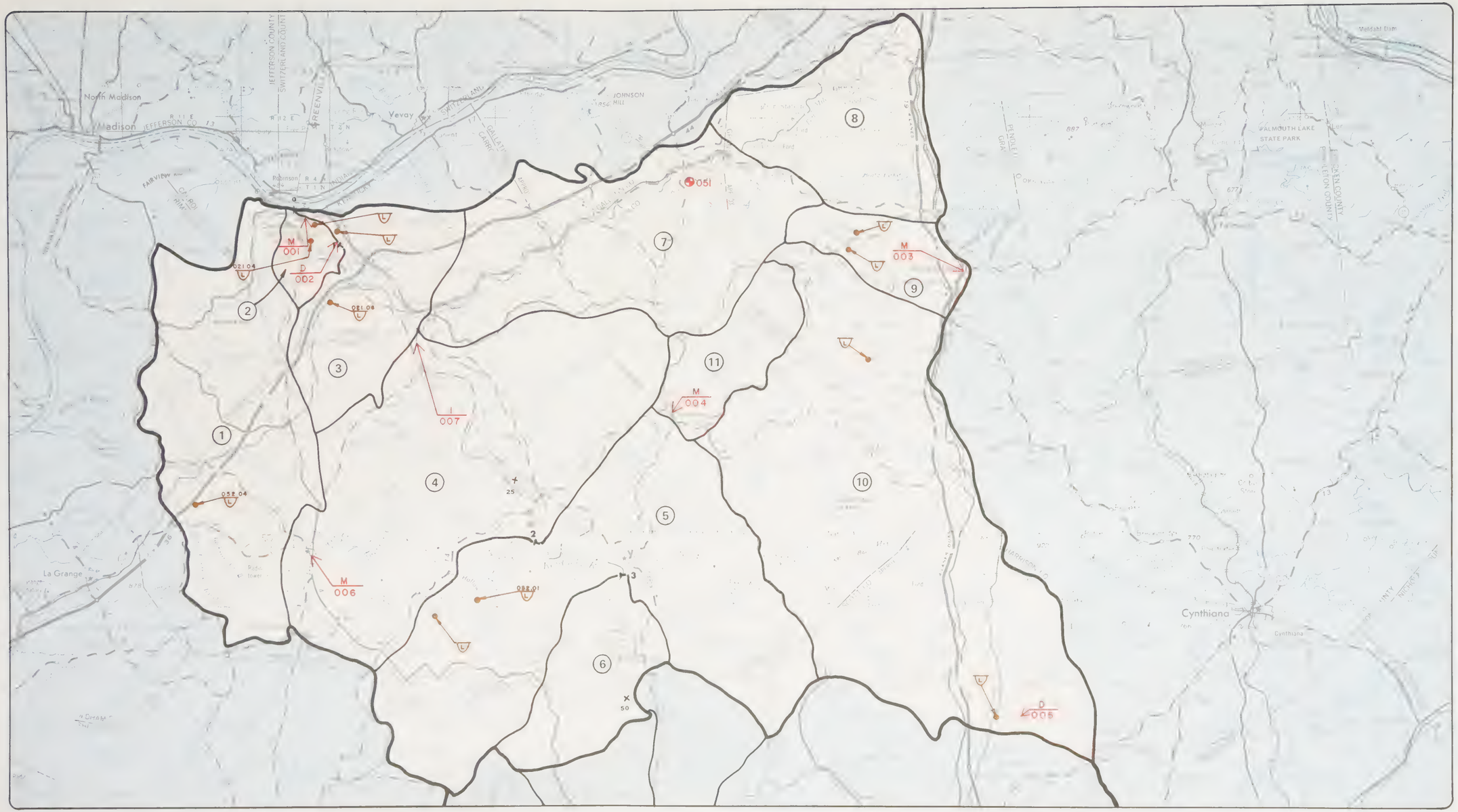

KENTUCKY RIVER BASIN

EXHIBIT B-1m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE	MAJOR	PRINCIPAL
DOMESTIC	M 100	M 100
MUNICIPAL	M 100	M 100
INDUSTRIAL	I 100	I 100
COOLING WATER	C 100	C 100

C.S. COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

LANDFILLS, DUMPS, JUNKYARDS

LUMBER OPERATIONS

SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

WATER QUALITY MONITORING
PRIMARY STATIONS
SECONDARY STATIONS

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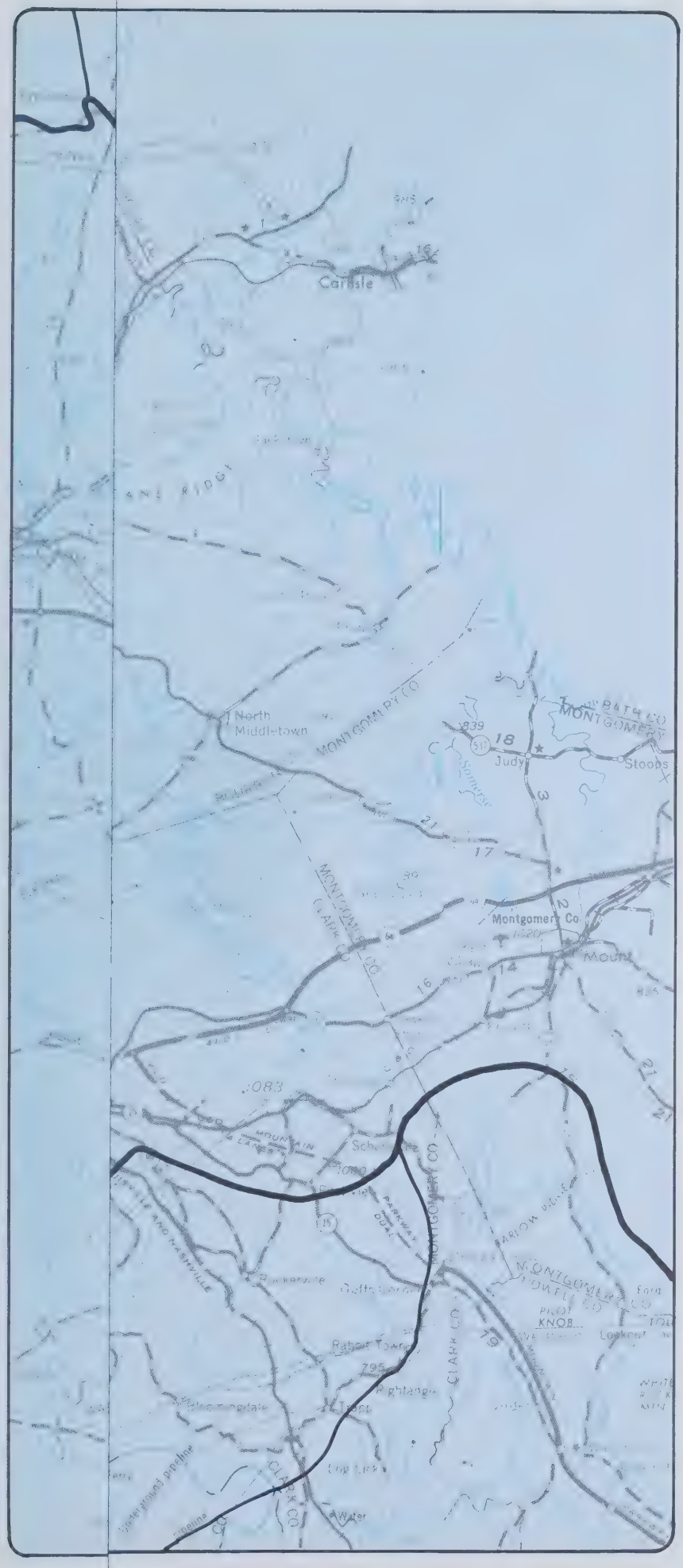

KENTUCKY RIVER BASIN

EXHIBIT B-2m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE — MAJOR	PRINCIPAL
DOMESTIC D/100	D/100
MUNICIPAL M/100	M/100
INDUSTRIAL I/100	I/100
COOLING WATER C/100	C/100

C.S. COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

LANDFILLS, DUMPS, JUNKYARDS

LUMBER OPERATIONS

SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

WATER QUALITY MONITORING
PRIMARY STATIONS
SECONDARY STATIONS

5 0 5

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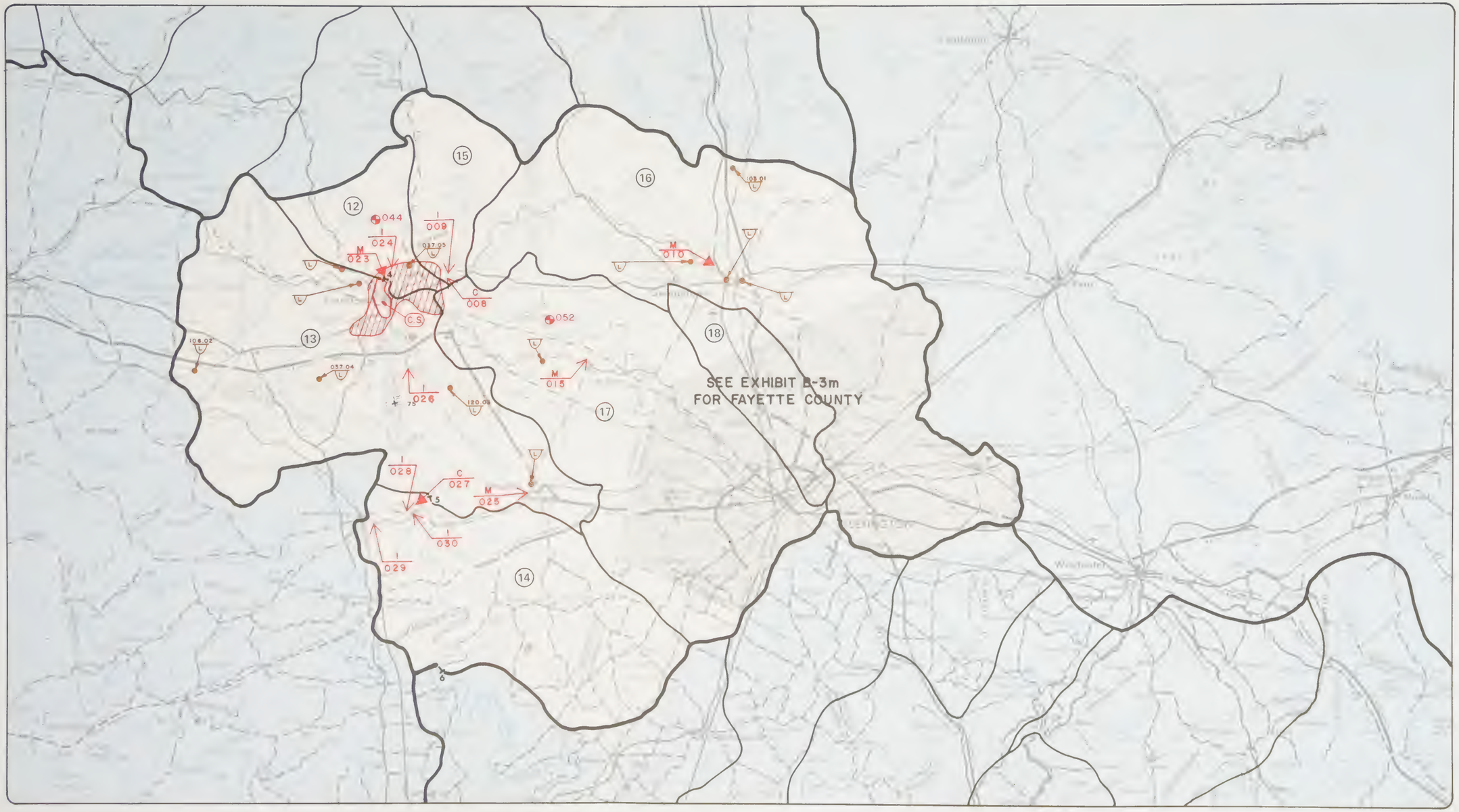

KENTUCKY RIVER BASIN

EXHIBIT B-2m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE — MAJOR	PRINCIPAL
DOMESTIC	
MUNICIPAL	
INDUSTRIAL	
COOLING WATER	

C.S. COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

LANDFILLS, DUMPS, JUNKYARDS

LUMBER OPERATIONS

SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

WATER QUALITY MONITORING
PRIMARY STATIONS
SECONDARY STATIONS

5 0 5

GRAPHIC SCALE IN MILES

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KENTUCKY RIVER BASIN

EXHIBIT B-3m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE — MAJOR — PRINCIPAL

DOMESTIC — D 100 — D 100

MUNICIPAL — M 100 — M 100

INDUSTRIAL — I 100 — I 100

COOLING WATER — C 100 — C 100

C.S. COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

LANDFILLS, DUMPS, JUNKYARDS

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SECONDARY STATIONS

5 0 5

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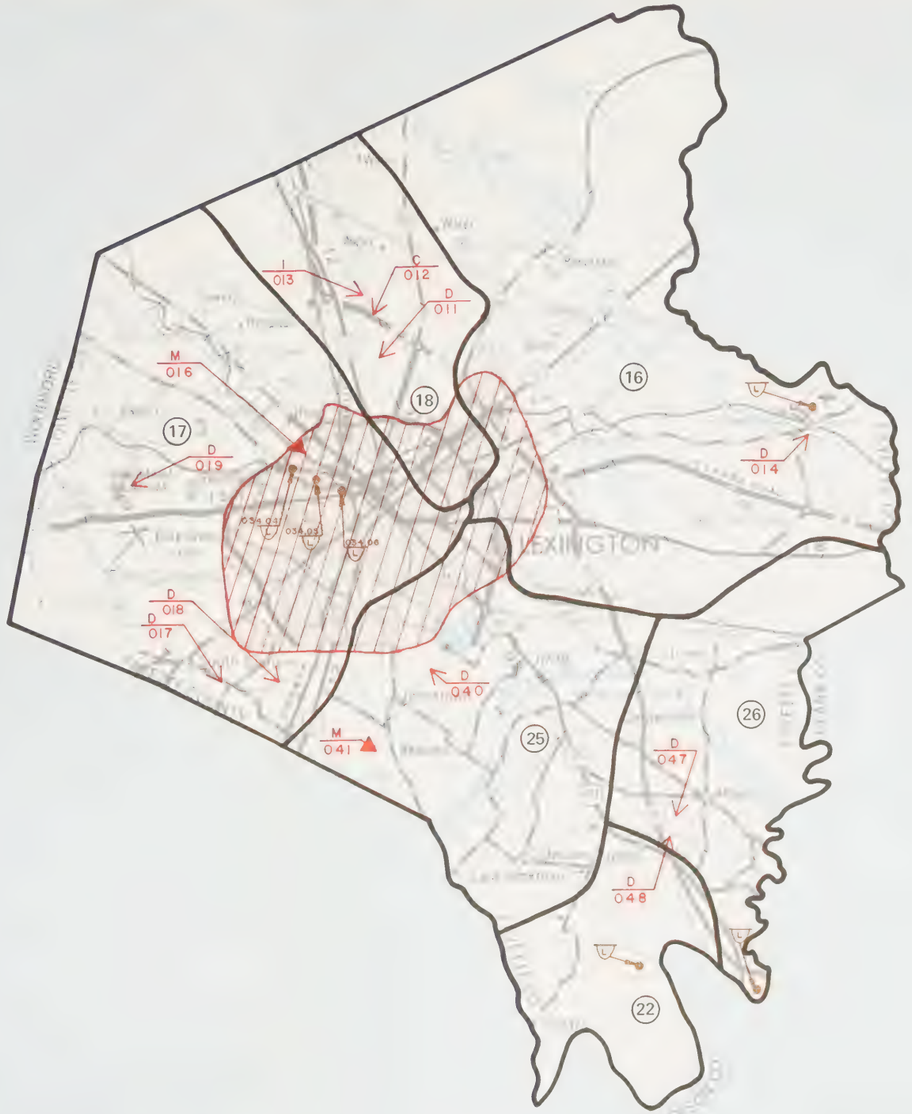

KENTUCKY RIVER BASIN

EXHIBIT B-3m

SEGMENT MAP

LEGEND

13 SEGMENT NUMBER

DISCHARGE —— MAJOR	PRINCIPAL
DOMESTIC D 100	D 100
MUNICIPAL M 100	M 100
INDUSTRIAL I 100	I 100
COOLING WATER C 100	C 100

- C.S. COMBINED SEWER AREA
- MINING OR QUARRYING ACTIVITY
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GRAPHIC SCALE IN MILES

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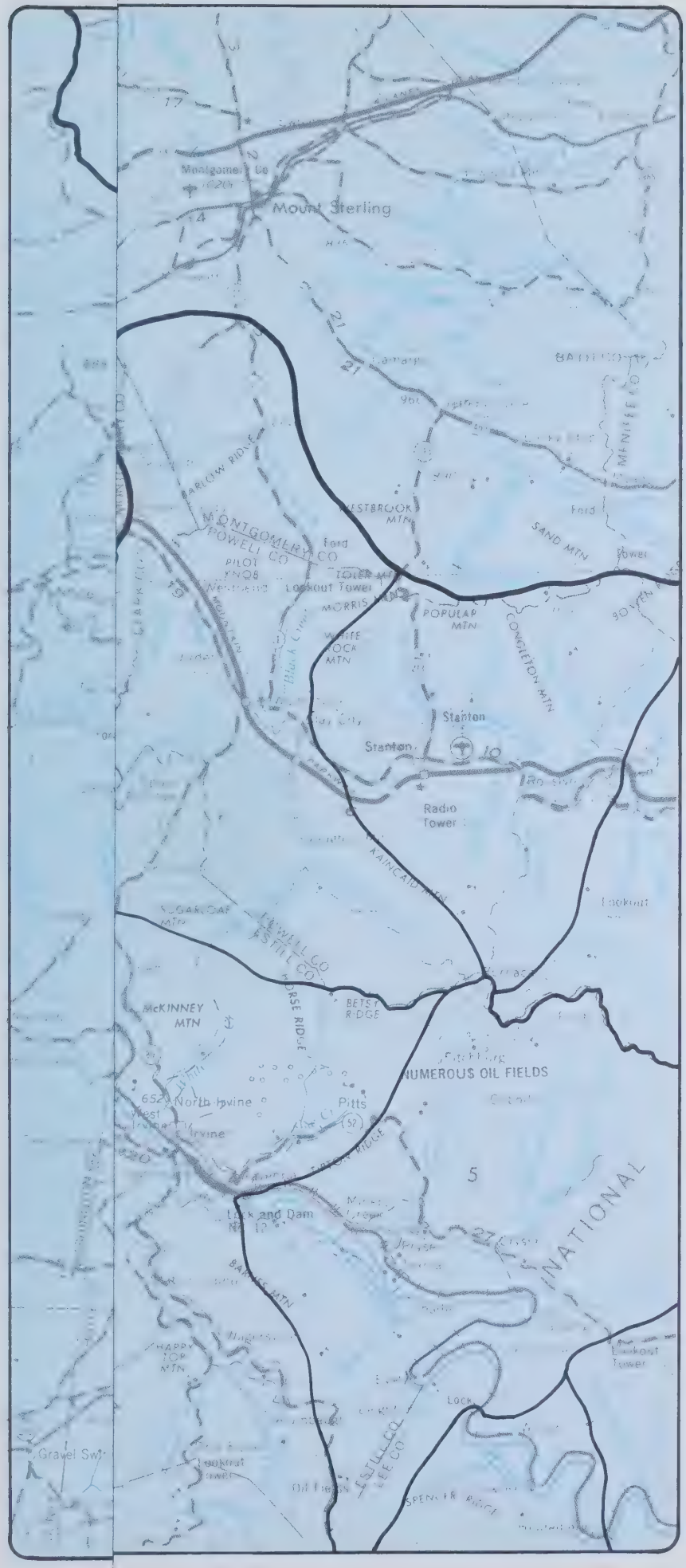

KENTUCKY RIVER BASIN

EXHIBIT B-4m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE	MAJOR	PRINCIPAL
DOMESTIC	D 100	D 100
MUNICIPAL	M 100	M 100
INDUSTRIAL	I 100	I 100
COOLING WATER	C 100	C 100

(C.S.) COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

LANDFILLS, DUMPS, JUNKYARDS

LUMBER OPERATIONS

SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

WATER QUALITY MONITORING

PRIMARY STATIONS

SECONDARY STATIONS

5 0 5

GRAPHIC SCALE IN MILES

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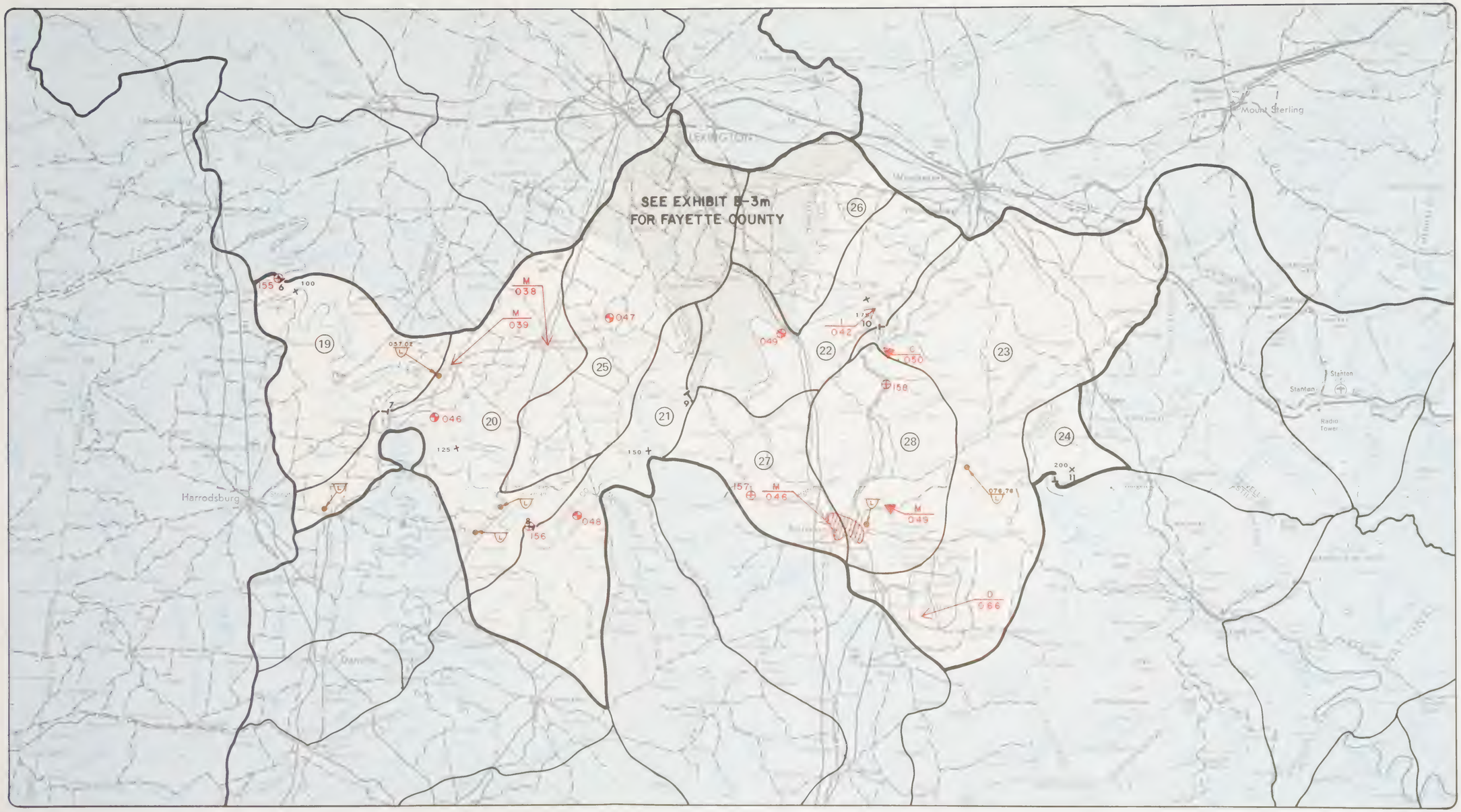

KENTUCKY RIVER BASIN

EXHIBIT B-4m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE — MAJOR — PRINCIPAL

- DOMESTIC
- MUNICIPAL
- INDUSTRIAL
- COOLING WATER

(C S) COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

LANDFILLS, DUMPS, JUNKYARDS

LUMBER OPERATIONS

SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

WATER QUALITY MONITORING
PRIMARY STATIONS
SECONDARY STATIONS

5 0 5

GRAPHIC SCALE IN MILES

Base Data U S Geological Survey

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Prepared for Division of Water Quality

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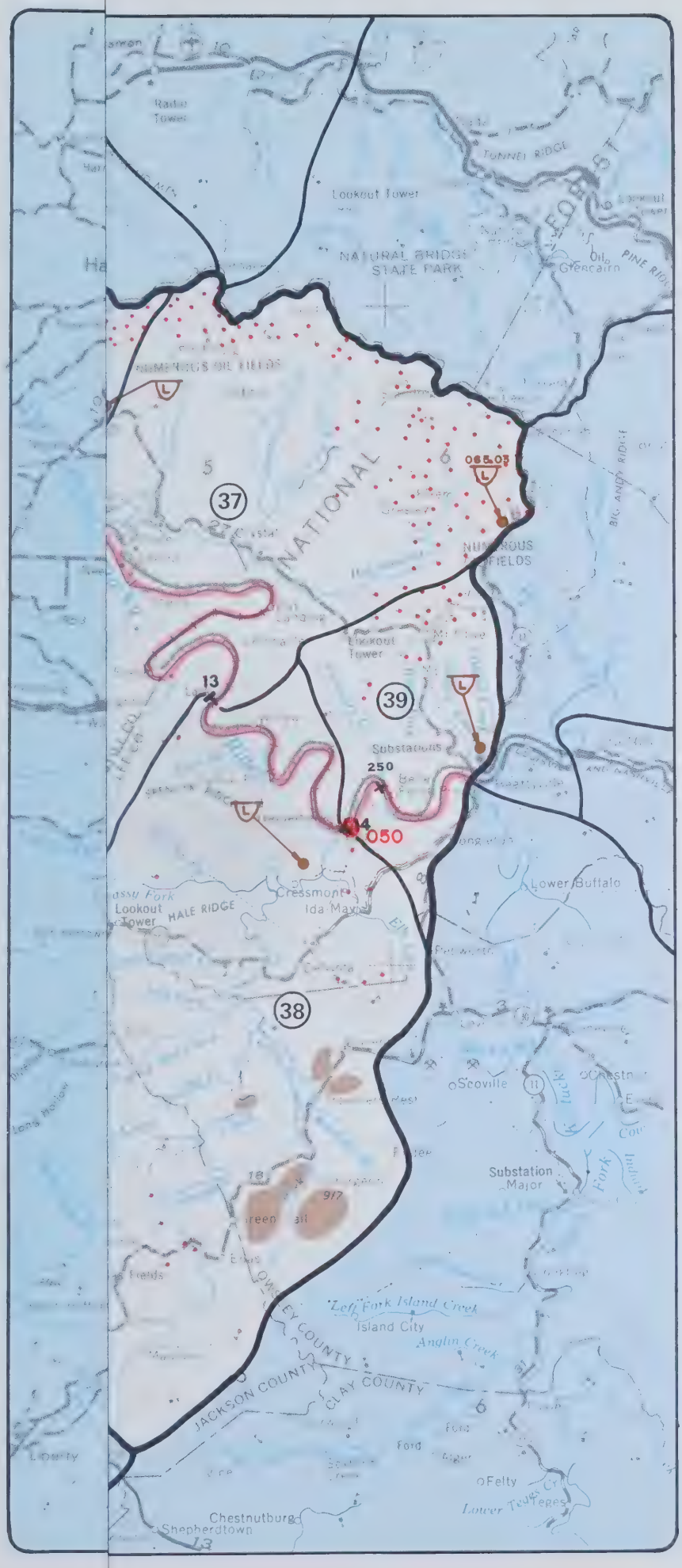

KENTUCKY RIVER BASIN

EXHIBIT B-5m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE —— MAJOR	PRINCIPAL
DOMESTIC D 100	D 100
MUNICIPAL M 100	M 100
INDUSTRIAL I 100	I 100
COOLING WATER C 100	C 100

- C.S. COMBINED SEWER AREA
- MINING OR QUARRYING ACTIVITY
- ACID MINE DRAINAGE
- SIGNIFICANT AFFECT
- INTERMITTENT AFFECT
- OIL RELATED
- LANDFILLS, DUMPS, JUNKYARDS
- LUMBER OPERATIONS
- SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS
- WATER QUALITY MONITORING
  - PRIMARY STATIONS
  - SECONDARY STATIONS

5 0 5

GRAPHIC SCALE IN MILES

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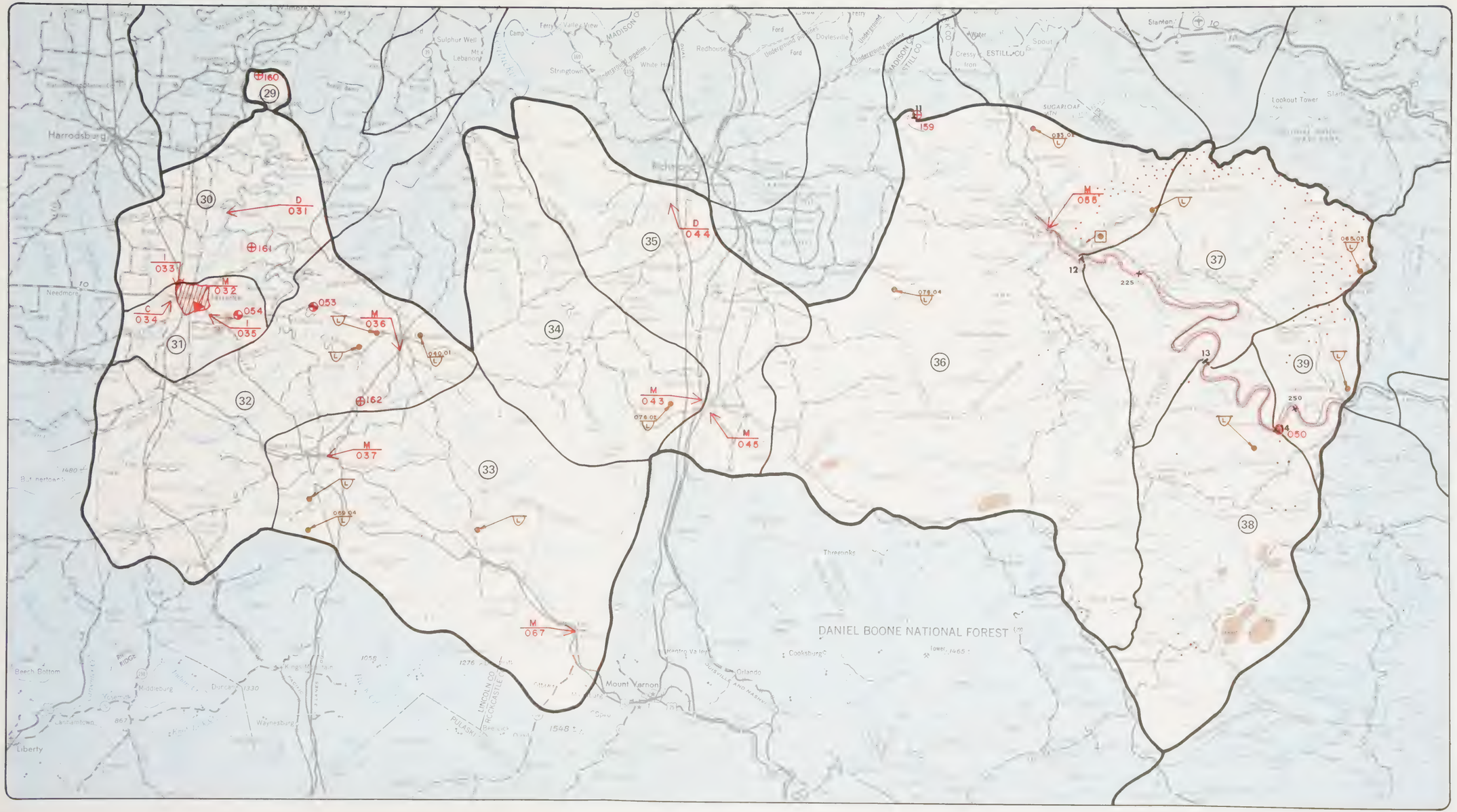

KENTUCKY RIVER BASIN

EXHIBIT B-5m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE — MAJOR — PRINCIPAL

- DOMESTIC — D 100 — D 100
- MUNICIPAL — M 100 — M 100
- INDUSTRIAL — I 100 — I 100
- COOLING WATER — C 100 — C 100
- CS COMBINED SEWER AREA
- MINING OR QUARRYING ACTIVITY
- ACID MINE DRAINAGE
  - SIGNIFICANT AFFECT
  - INTERMITTENT AFFECT
- OIL RELATED
- LANDFILLS, DUMPS, JUNKYARDS
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5 0 5

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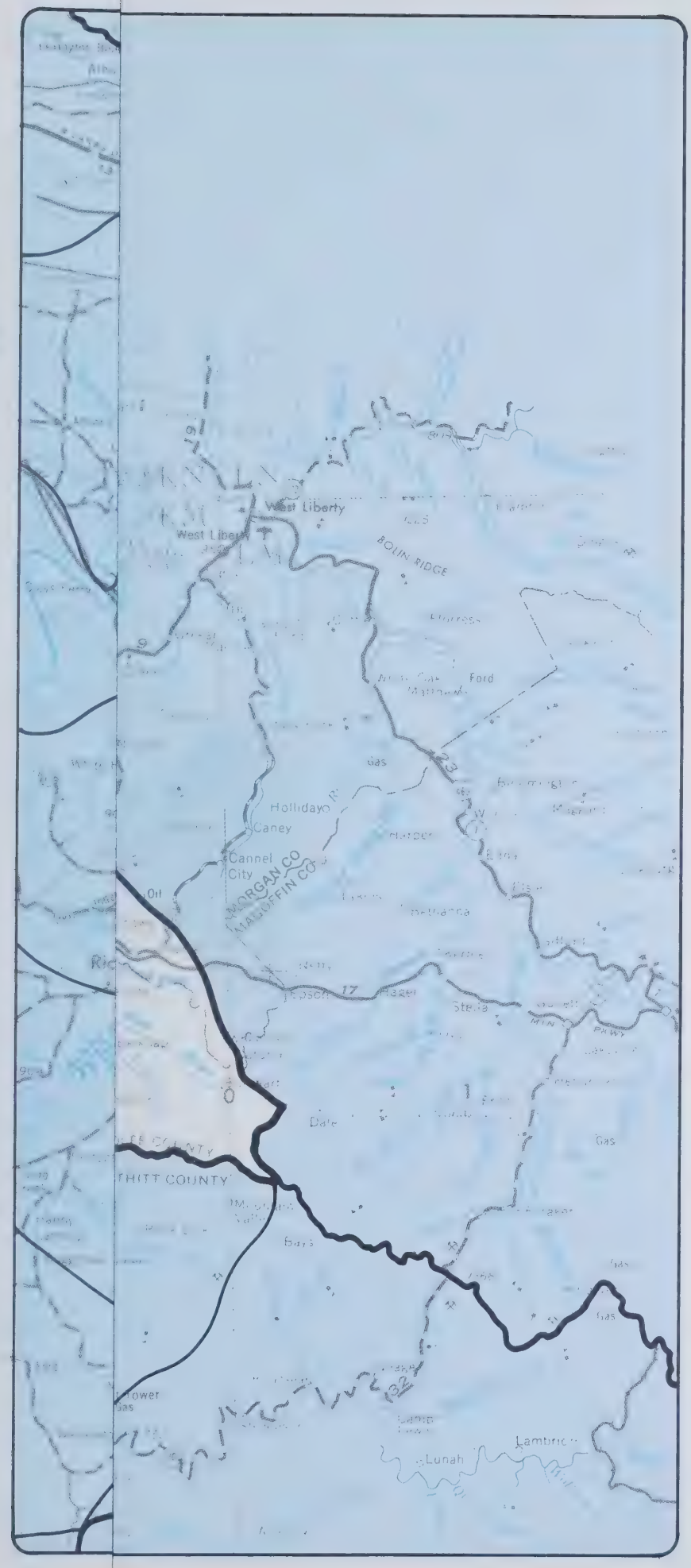

KENTUCKY RIVER BASIN

EXHIBIT B-6m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE —— MAJOR	PRINCIPAL
DOMESTIC	D 100
MUNICIPAL	M 100
INDUSTRIAL	I 100
COOLING WATER	C 100

C.S. COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

LANDFILLS, DUMPS, JUNKYARDS

LUMBER OPERATIONS

SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

WATER QUALITY MONITORING

PRIMARY STATIONS

SECONDARY STATIONS

5 0 5

GRAPHIC SCALE IN MILES

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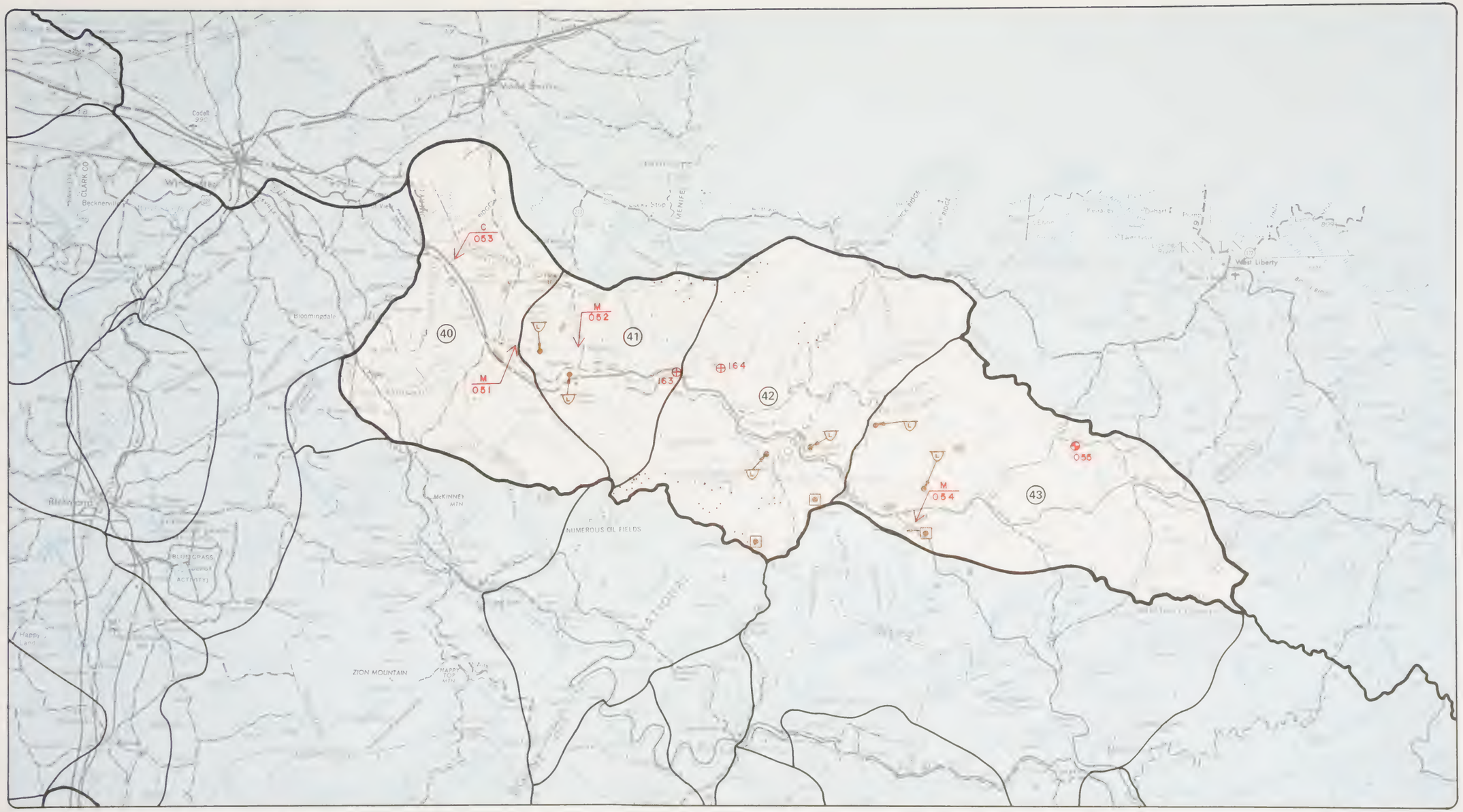

KENTUCKY RIVER BASIN

EXHIBIT B-6m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE —— MAJOR	PRINCIPAL
DOMESTIC	D 100
MUNICIPAL	M 100
INDUSTRIAL	I 100
COOLING WATER	C 100

C.S. COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

LANDFILLS, DUMPS, JUNKYARDS

LUMBER OPERATIONS

SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

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PRIMARY STATIONS
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5 0 5

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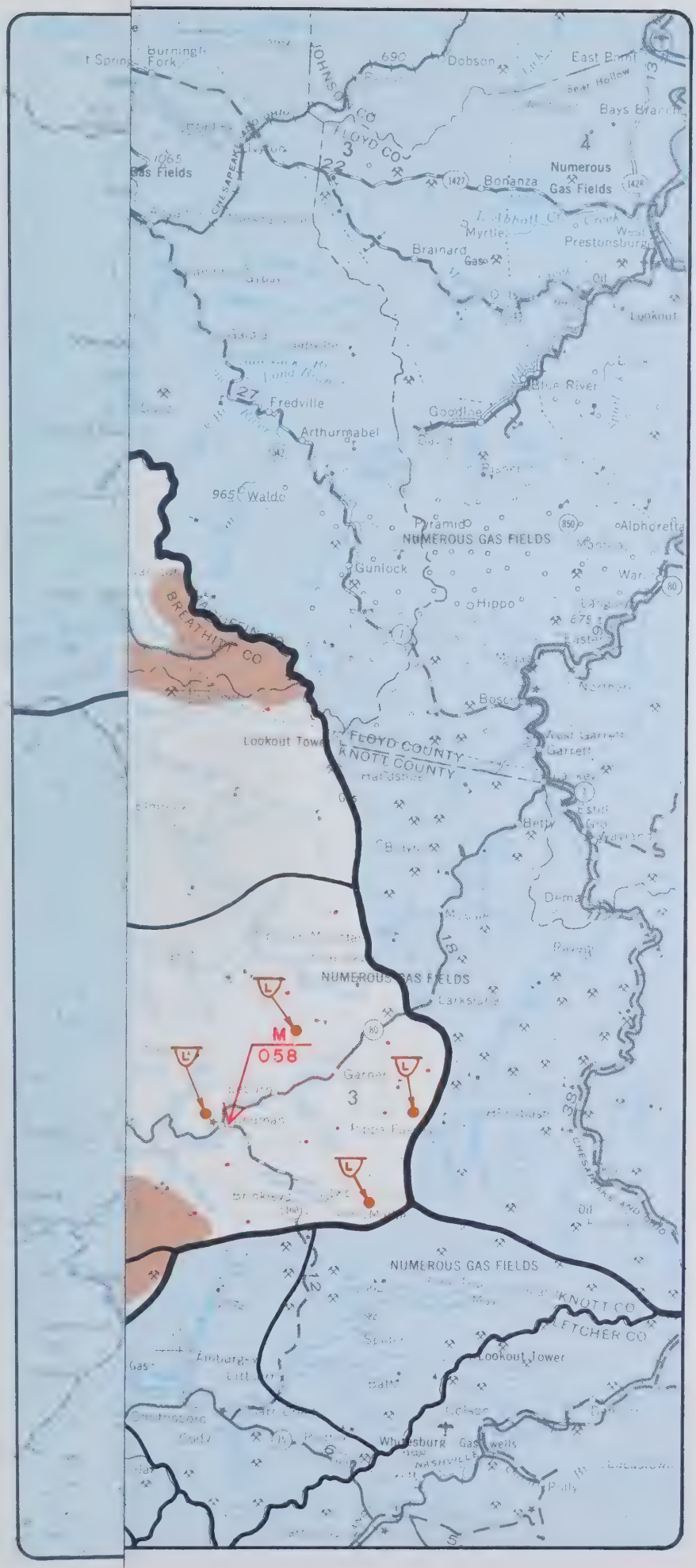

KENTUCKY RIVER BASIN

EXHIBIT B-7m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE — MAJOR		PRINCIPAL
DOMESTIC	D 100	D 100
MUNICIPAL	M 100	M 100
INDUSTRIAL	I 100	I 100
COOLING WATER	C 100	C 100

- C.S. COMBINED SEWER AREA
- MINING OR QUARRYING ACTIVITY
- ACID MINE DRAINAGE
- SIGNIFICANT AFFECT
- INTERMITTENT AFFECT
- OIL RELATED
- L LANDFILLS, DUMPS, JUNKYARDS
- LUMBER OPERATIONS
- SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS
- WATER QUALITY MONITORING
  - PRIMARY STATIONS
  - SECONDARY STATIONS

5 0 5

GRAPHIC SCALE IN MILES

Base Data: U S Geological Survey

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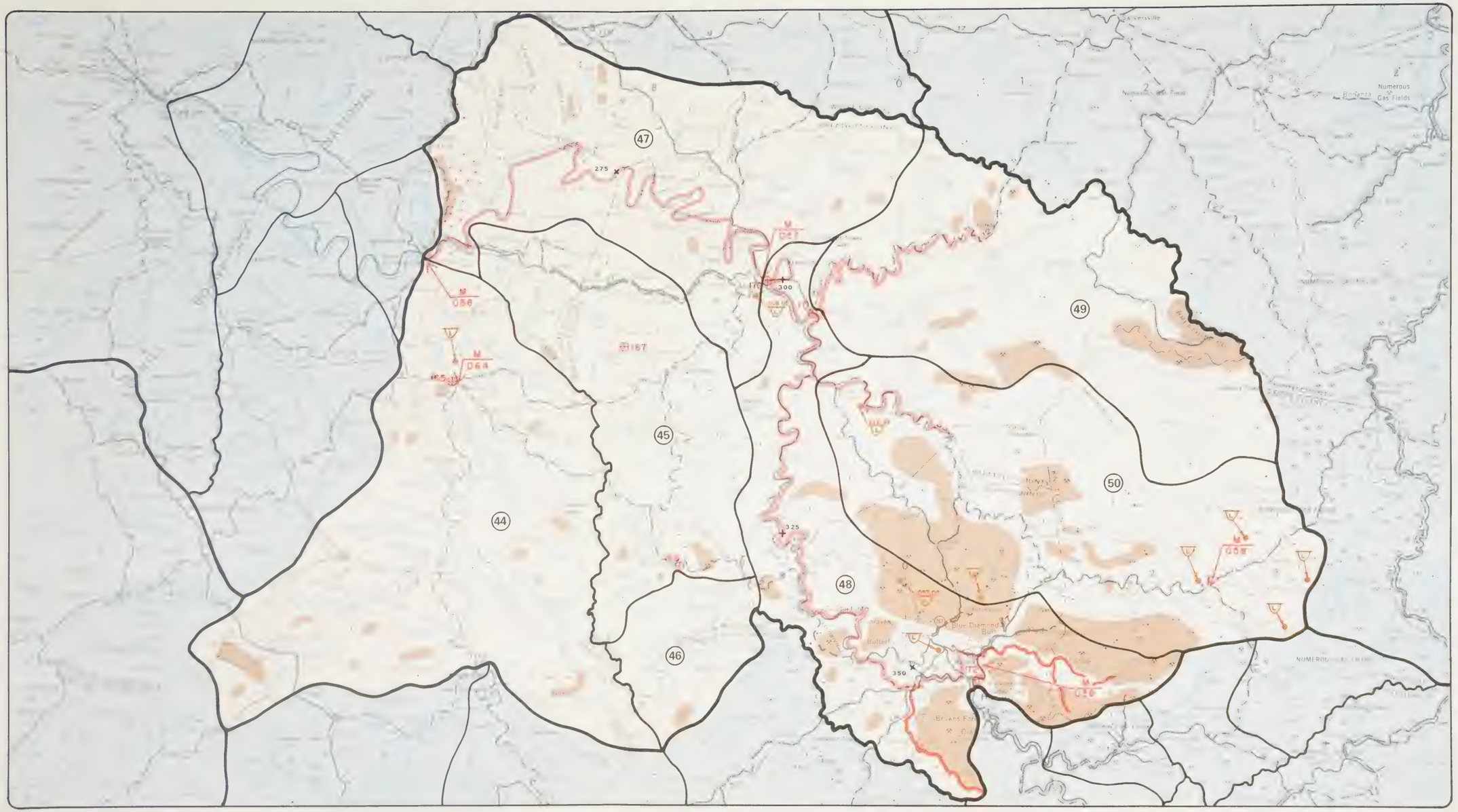

KENTUCKY RIVER BASIN

EXHIBIT B-7m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE — MAJOR — PRINCIPAL

- DOMESTIC
- MUNICIPAL
- INDUSTRIAL
- COOLING WATER
- COMBINED SEWER AREA
- MINING OR QUARRYING ACTIVITY
- ACID MINE DRAINAGE
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5 0 5

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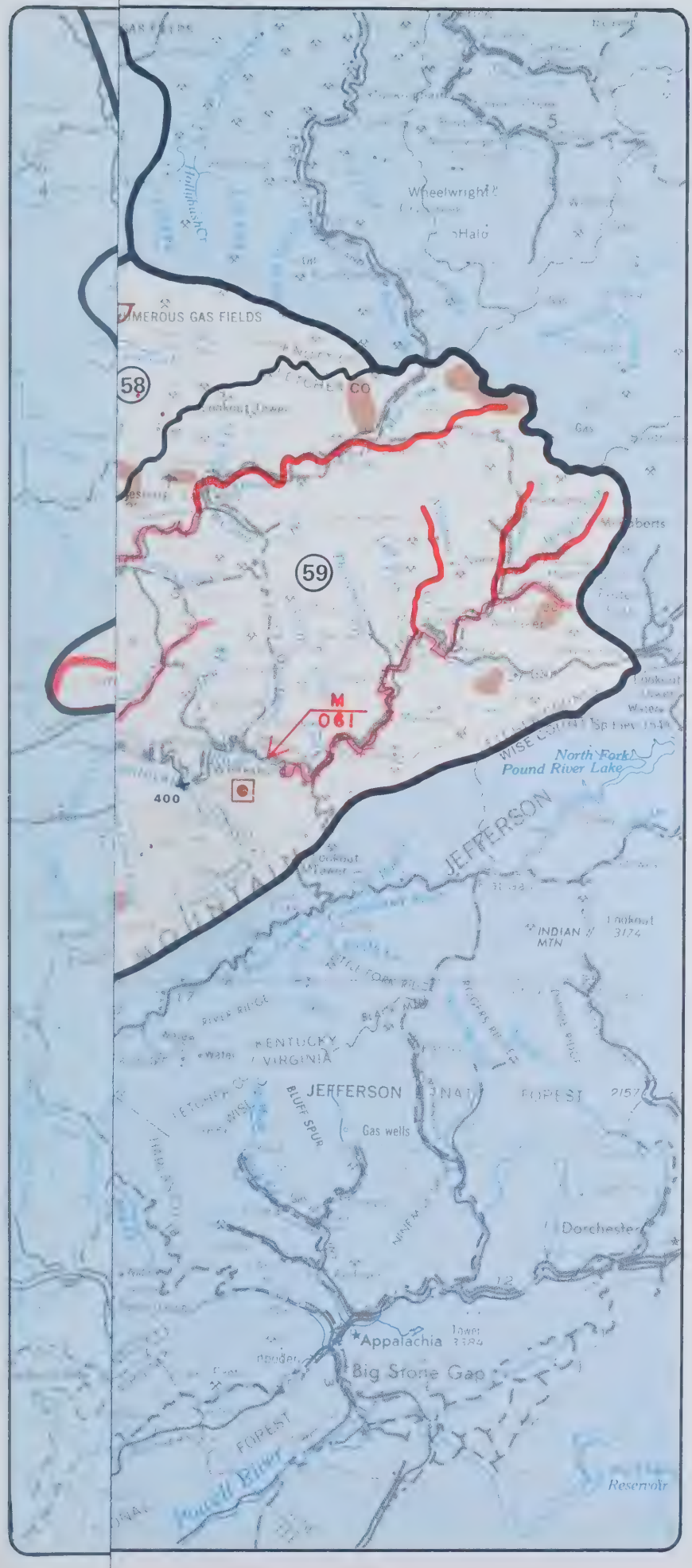

KENTUCKY RIVER BASIN

EXHIBIT B-8m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE — MAJOR	PRINCIPAL
DOMESTIC	D 100
MUNICIPAL	M 100
INDUSTRIAL	I 100
COOLING WATER	C 100

C.S. COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

L LANDFILLS, DUMPS, JUNKYARDS

LUMBER OPERATIONS

SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

WATER QUALITY MONITORING
PRIMARY STATIONS
SECONDARY STATIONS

5 0 5

GRAPHIC SCALE IN MILES

Base Data: U S Geological Survey

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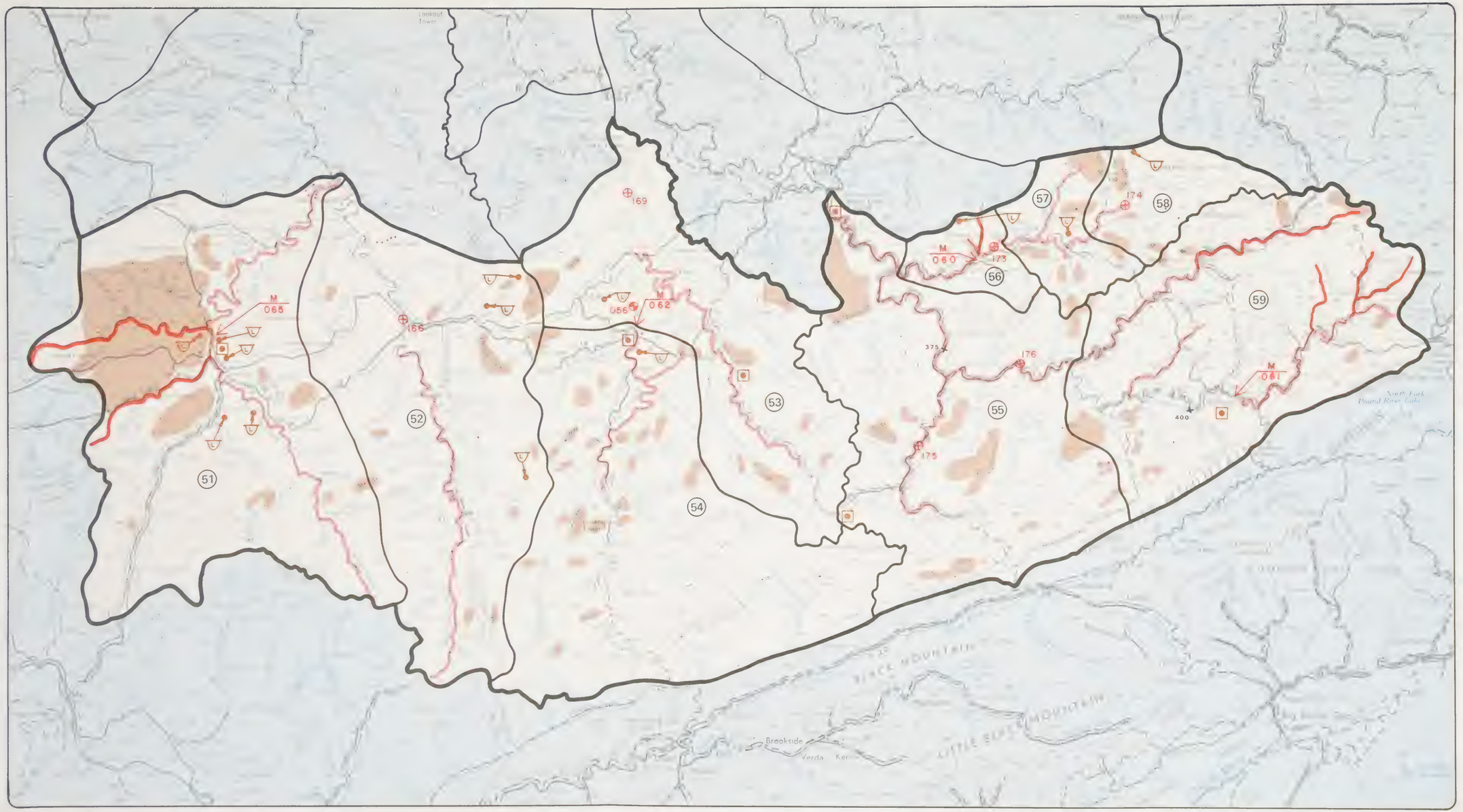

KENTUCKY RIVER BASIN

EXHIBIT B-8m

SEGMENT MAP

LEGEND

(13) SEGMENT NUMBER

DISCHARGE — MAJOR — PRINCIPAL

- DOMESTIC
- MUNICIPAL
- INDUSTRIAL
- COOLING WATER

(CS) COMBINED SEWER AREA

MINING OR QUARRYING ACTIVITY

ACID MINE DRAINAGE

SIGNIFICANT AFFECT

INTERMITTENT AFFECT

OIL RELATED

LANDFILLS, DUMPS, JUNKYARDS

LUMBER OPERATIONS

SEPTIC TANK DRAINAGE OR UNBAN RUNOFF PROBLEMS

WATER QUALITY MONITORING
PRIMARY STATIONS
SECONDARY STATIONS

5 0 5

GRAPHIC SCALE IN MILES

Base Data U. S. Geological Survey

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APPENDIX B

SEGMENT ANALYSIS FOR THE KENTUCKY RIVER BASIN

INTRODUCTION

The Kentucky River Basin has been divided into fifty-nine separate hydrologic units designated as "segments" in accordance with P.L. 92-500 and applicable regulation (See Chapter 4 for definition). These hydrologic units or segments were classified as either Water Quality Limited or Effluent Limited based on stream flow and applied waste load. Each Segment will be analyzed using available water quality data. The location of each segment is described in detail and the lower and upper boundaries located by river mile (RM) points. A classification was assigned as previously described in Chapter 4 using the main stem of the segment stream as the controlling water for segment classification. Tributary streams within the segment will be evaluated with respect to the effect they may have on the segment as a whole. In the event a tributary stream contains a heavy waste load and water quality standards are violated in the tributary stream, sufficient treatment will be specified to allow the tributary stream to meet water quality standards and thereby prevent degradation of water quality on the main stem segment waters.

The hydrology of each segment is discussed in sufficient detail to permit an evaluation of hydrologic conditions prevailing in the segment.

Water quality has been reviewed for the waters of each segment when available, and the source of such data cited. In some cases personal observations were used in lieu of unavailable data.

All point source dischargers are identified to the extent possible. Significant dischargers, where applicable, have been assigned a waste load allocation in terms of maximum daily total oxygen demand (TOD) in pounds per day.

Based on the factors of population within the segment, non-point sources, discharges and severity of pollution, each segment was assigned a numerical priority rating.

Municipal needs were determined using available data from Area Development District (ADD) plans, 201 Facilities Plans, other plans and information from the Division of Water and personal observations. The municipal needs were projected over a ten year span and costs developed for meeting these needs.

Where applicable, alternate water quality management plans were discussed on a broad basis with respect to objectives and alternatives.

EXHIBITS B-1m through B-8m were prepared on 1:250,000 scale maps showing the location of each significant municipal, domestic and industrial discharger, permitted sanitary landfills, combined sewer areas; urban areas; urban runoff and mine drainage problems.

An understanding of the waste load allocation formula, segment priority formula and abatement priority formula is essential to proper interpretation of segment information and for this reason the following discussion is repeated.

Waste Load Allocation

Two quantities are defined for Water Quality Limited segments. These are: Maximum Theoretical Daily Load (MTDL) and Total Maximum Daily Load (TMDL). Both are to be expressed as pounds of total oxygen demand (TOD) per day.

Maximum Theoretical Daily Load (MTDL)

MTDL = 17.2 Ka x t x Q

Ka is the reaeration factor determined by a computer output and varies from 0.0 to 0.65.

t is the time of travel through the segment.

Q is the average flow through the segment in cubic feet per second (cfs).

Example Calculation:

Assumptions: Ka = 0.2; t = 3 days and Q = 25 cfs

MTDL = 17.2 x 0.2 x 3 x 25 = 258 pounds per day.

This figure is the total daily oxygen assimilative capacity of the segment stream.

Total Maximum Daily Load (TMDL)

TMDL = 8.34 x Q x TOD

Q is the 1980 discharge in million gallons per day (MGD)

TOD is the total oxygen demand in mg/l produced by the proposed treatment level as indicated below:

Treatment Level	TOD (mg/l)
T1	135
T2	98
T3	83
T4	20
T5	9

Example Calculation:

Assumptions: Discharge from a 5 MGD plant providing T-2 treatment

TMDL = 8.34 x 5 x 98 = 4087 pounds per day

Should more than one discharger be located in the segment, a separate calculation shall be made for each discharger. A summation of the results of all such dischargers equals the TMDL of the segment.

Segment Priority

The segment priority was determined using the following factors: (1) Population, (2) Non-Point Source pollution, (3) Severity of pollution.

The population factor is 1975 population in thousands.

A non-point source factor ranging from 0.0 to 100 has been assigned to applicable segments having non-point source pollution. This factor is based on sound judgment subsequent to evaluating contributing non-point source pollution potentials. Severity of Pollution (SP) was calculated using the following formula:

SP = 8.34 x Q(BOD-5 + SS + NH3-N + Metals)

Where Q is the 1975 average daily flow from the discharging facility, values assigned to BOD-5, SS, NH3-N, and metals is the difference between existing effluent values for each parameter and values for each of the parameters in the effluent from the proposed upgraded wastewater treatment facility.

Example Calculation for Severity of Pollution

Assumptions: One discharger in the segment having a 1975 average daily flow of 1 MGD requiring T4B treatment level. Existing effluent discharge characteristics, BOD-5 = 15; SS = 20; NH3-N = 6; metals= 0 (all in mg/l).

Characteristics of a T4B effluent are: BOD = 10; NH3-N = 1; SS = 15 (all in mg/l).

In the formula BOD-5, NH3-N, SS, and metal values are expressed as the difference between existing values and expected values that result from proposed additional treatment.

SP = 8.34 x 1.0(15-10) + (20-15) + (6-1) + (0-0) = 8.34 x 1(5+5+5+0) = 125.

The Segment Priority is then calculated using the above data as follows:

Population	10.1
Severity of Population (SP)	125.0
Non-Point source	50.0
Segment Priority	185.1

Abatement Priority

The abatement priority was calculated using the following criteria: (1) the segment priority (negating metals, thermal pollution, and non-point sources), (2) the national interest, (3) the "needs" survey, and (4) status of 201 Facilities Planning.

The total estimated cost of a project within a given segment is used as the basis for assigning fractional proportions of the total cost to items 1 through 5 listed below. The fractional portion of the total cost applicable to each of the items 1 through 5 below is then multiplied by the factor listed in the adjacent column of 1 through 5 below. The proportion of the total cost for each item and the factor is multiplied by the segment priority to obtain a numerical subtotal for each of the appropriate items. The total accumulated numerical number represents the Abatement Priority.

Needs		Multiplier Factor
1.	Treatment	
	T1	2.0
	T2	2.5
	T3	3.5
	T4	4.5
	T5	6.0
2.	Inflow/Infiltration	1.5
3.	Interceptor Sewers	2.0
4.	Collection Sewers	1.0
5.	Combined Sewers	0.5

Subsequent to obtaining the priority number a capital letter, A, B or C, is assigned based on population of the community as follows:

"A" - for a community in a SMSA

"B" - for a community not in a SMSA having a population in excess of 10,000

"C" - for a community not in a SMSA having a population less than 10,000

An additional lower case letter, a, b, or c is assigned for the purpose of designating the status of 201 Facilities Planning as follows:

"a" - Step No. 1 initiation

"b" - Step No. 2 initiation

"c" - Step No. 2 completion

Example Calculation of Abatement Priority:

Assumptions: Treatment level required T2A, Population 50,000 not in SMSA, 201 Facilities Planning initiated.

(1)	Treatment level required T2	Cost	$ 200,000
(2)	Inflow/Infiltration required	Cost	150,000
(3)	Interceptors required	Cost	50,000
(4)	Collection Sewers required	Cost	300,000
(5)	Combined sewers separation	Cost	300,000
Total Cost			$1,000,000

Fractions of the total cost for each of the above 5 items are as follows:

(1) $\frac{200,000}{1,000,000} = 0.20$

(2) $\frac{150,000}{1,000,000} = 0.15$

(3) $\frac{50,000}{1,000,000} = 0.05$

(4) $\frac{300,000}{1,000,000} = 0.30$

(5) $\frac{300,000}{1,000,000} = 0.30$

	Proportional Cost	Multiplying Factor	Segment Priority	Abatement Sub-Total
(1)	0.20	2.5	400	200
(2)	0.15	1.5	400	90
(3)	0.05	2.0	400	40
(4)	0.30	0.5	400	120
(5)	0.30	0.5	400	70
Construction Abatement Priority				520

Based on the above example, the Abatement Priority designation is 520 Ba.

Finally it should be clearly pointed out that data presented in the Segment Analysis is subject to refinement through the mechanism of 201 Facilities Planning. It is clearly the intent of P.L. 92-500 and appurtenant regulations thereto that River Basin Plans shall be refined and updated as additional information becomes available through the implementation of other program requirements of P.L. 92-500.

SEGMENT #1 ANALYSIS
434.8-0.01

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 5.2

Location

The Little Kentucky River stretches from its confluence with the Ohio River at River Mile 434.8 to its headwaters. The segment consists predominately of farm land. The City of Bedford is partially located in Segment #1, which lies in portions of Carroll, Trimble and Henry Counties.

Basic Planning Data

Segment #1 contains rural portions of three counties including 15.3 square miles of Carroll County, 46.5 square miles of Trimble County and 64.4 square miles of Henry County. The rural non-farm communities of Campbellsburg and Smithfield are located in the Henry County portion of the segment while the Trimble County portion contains the rural non-farm community of Bedford.

Bedford, the largest of the three non-farm communities in the segment, has an estimated 1975 population of 840, which is projected to increase to 1,050 by 1995.

The population of the entire segment was estimated to be 4,989 in 1975 and is projected to increase to 5,888 by 1995.

Land use in the segment includes an estimated 88.3 square miles of agricultural land and 37.7 square miles of woodland and forest.

Exhibit B-1.1t Basic Planning Data

Segment #1	Projection Years 1970	1975	1980	1995
Population Total	4,778	4,989	5,217	5,888
Rural	4,778	4,989	5,217	5,888
Farm	3,334	3,465	3,617	4,028
Non-Farm	1,444	1,524	1,600	1,860
Urban	-	-	-	-
Housing Unit Total	1,552	1,674	1,836	2,350
Rural	1,552	1,674	1,836	2,350
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	88.3	88.3	88.2	88.2
Silviculture	37.7	37.7	37.7	37.7
Mining	-	-	-	-
Construction	-	-	0.1	-
Urban	0.2	0.2	0.3	0.3

Classification

The stream has good overall water quality since there are no present dischargers in the drainage area and none expected in the immediate future. For this reason, it is classified as an Effluent Limited segment.

Segment Hydrology

The Little Kentucky River frequently has zero flow during dry weather periods. Due to this fact, it has extremely limited assimilative capacities and the location of any treatment plants to discharge into the Little Kentucky River requires a T4B treatment level. The stream varies from an elevation of 919 feet (MSL) to 425 feet (MSL) and has an average slope of 12.5 feet per mile. The segment is predominately located in the Outer Bluegrass Physiographic Region and has a drainage basin area of 132.9 square miles.

Water Quality Data

There are no water quality records on the Little Kentucky River and immediate sampling does not seem to be necessary since there are no dischargers presently in the segment.

Point Source Dischargers

There are no significant or insignificant dischargers into the Little Kentucky River.

Non-point Source Dischargers

There are no significant non-point source dischargers in the Little Kentucky River sub-basin. All lands within the basin are either agricultural or forested. Bottom lands along the Little Kentucky River are used extensively for the growing of corn and tobacco. Some sedimentation occurs as a result of storm water run-off. However, sedimentation is not significant. Septic tanks function poorly due to unsuitable soils, although the amount of pollution caused by such malfunctioning facilities has little or no significant impact of water quality of this basin.

Waste Load Allocation and Priority

Since there are no dischargers into the Little Kentucky River, there are no waste load allocations for the segment, and the segment priority is a direct function of the population. This priority is determined using the following factors:

Population	5.2
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	5.2

Municipal Needs

The City of Bedford is located partially within the Basin. The most advantageous location for any future plant site appears to be in the Little Kentucky River Basin. A 201 Facilities Plan application has been submitted to the state and federal agencies for funding. The city is presently without public sewers or treatment facilities, consequently a wastewater collection and treatment system is needed. It is estimated that municipal needs for treatment, pumping stations and collection will cost $400,000. More accurate and detailed costs will become available upon completion of the 201 Facility Plan.

Alternative Water Quality Management Plan

There are no alternative management plans at present, however should construction of wastewater facilities become a reality for the City of Bedford, discharge of the effluent could be to Barebone Creek, a tributary to the Ohio River or to Town Branch, a tributary of the Little Kentucky River. The treatment alternative of land disposal of the effluent should be considered for this small municipality.

SEGMENT #2 ANALYSIS

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 550

Location

Segment #2 is located on the main stem of the Kentucky River from its mouth at the confluence with the Ohio to Lock and Dam Number 1 at river mile 4.0. The computer segment number and description is 435.6-0/4.0.

Classification

The water classification is Effluent Limited and the overall water quality in the segment is very good, due primarily to the extremely high seven day ten year low flow (280.3 cfs) and the resulting assimilative capacity.

Basic Planning Data

Segment #2 contains the urban community of Carrollton, the rural non-farm community of Prestonville and just over ten (10) square miles of rural Carroll County. Carrollton's population has increased steadily since 1960 with an estimated population in 1975 of 3,992. The city's population is projected to increase to 6,004 by 1995.

Principle employers in Carrollton include the Consolidated Aluminum Company, manufacturer of aluminum extrusions; Dow Corning Corporation manufacturer of silicones; and the Kawner Company, producer of aluminum appliance trim and auto parts.

Carrollton, being the only urban center in Carroll County and located within close proximity of an interchange access to I-71, will likely continue to be the center of residential, commercial and industrial activity in the county. The urban area currently comprises approximately 1.8 square miles with an additional square mile of agricultural land projected to be given over to urban development by 1995.

Exhibit B-2.1t Basic Planning Data

Segment #2	Projected Years			
	1970	1975	1980	1995
Population Total	4,496	4,647	4,800	6,652
Rural	612	655	700	648
Farm	360	383	408	316
Non-Farm	252	272	292	332
Urban	3,884	3,992	4,100	6,004
Housing Unit Total	1,453	1,533	1,621	2,450
Rural	197	216	236	291
Urban	1,256	1,317	1,385	2,159
Land Use (Sq. Mi.)				
Rural				
Agriculture	6.8	6.7	6.5	5.8
Silviculture	3.3	3.3	3.3	3.3
Mining	-	-	-	-
Construction	-	0.1	0.2	0.7
Urban	1.8	1.9	2.1	2.8

Segment Hydrology

At the mouth of the Kentucky River the 10 year seven day low flow is quite high (280.3 cfs) due to 14 lock and dams above the mouth and over seven thousand square miles of drainage area.

There are a number of proposed dam locations in the basin including the Red River Dam, Booneville Lake and a few other smaller areas. When these are completed they will cause an even greater seven day ten year low flow in Segment 002 due to low flow and augmentation upstream from the segment.

There are no perennial streams in Segment 002 other than the main stem of the Kentucky River.

Water Quality Data

The general water quality in Segment 002 is quite good due to the high flows at all periods. There is some loss of water quality around the City of Carrollton municipal treatment plant's effluent discharge since presently the city only has primary treatment. However, when the present treatment plant is upgraded to provide secondary treatment the main stem quality will meet present stream standards and, therefore, Segment 002 is classified as an "Effluent Limited" segment.

Point Source Dischargers

The only significant point source in Segment 002 is the municipal plant for the City of Carrollton. At the present time, this plant provides primary treatment only before discharging its effluent. All point sources in the segment are listed in **EXHIBIT** B-2.2t along with their effluent characteristics.

Non-Point Source Discharges

There are no identifiable significant non-point sources in the segment. There are some minor non-point sources such as urban runoff from the City of Carrollton and a few overflows from storm sewers, but neither of these problems is great enough to seriously affect water quality.

Waste Load Allocations and Priority

The waste load allocation model run in the basin shows that a T1A treatment level is sufficient for the City of Carrollton municipal discharger to meet stream standards. The associated daily loads for Segment 002 are shown in **EXHIBIT** B-2.3t.

The priority of Segment 002 is calculated as follows:

Population Factor =	4.0
Present Effluent Waste Load Factor =	546
Non-Point Source Factor =	0
Total Priority for Segment 002 =	550

The municipal discharger at Carrollton, therefore, has a fairly high priority and should be upgraded to secondary treatment as soon as possible. The compliance goal for this action is set for June 30, 1977 so as to comply with federal regulations that become effective on that date.

The discharger itself has a construction abatement priority of 671.

Municipal Needs

In order to meet the compliance goals for 1980 and 1995 the Carrollton sewage treatment plant must upgrade to a high rate secondary biological treatment plant. This means at least a contact stabilization plant, but in view of all factors, it might be feasible to go to an extended aeration plant. Exhibit B-2.5t displays the municipal needs for the plant and the related costs.

Exhibit B-2.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Carrollton)				
Treatment	.160	2.0	550	176.0
I/I	.040	1.5	550	33.0
Collectors	.480	1.0	550	264.0
Interceptors	.133	2.0	550	146.7
Combined Sew.	.187	0.5	550	51.3
Total Abatement Priority				671

Exhibit B-2.5t - Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04001	Carrollton STP	T1A / T1A	1,220 lbs./day	T - 0.6 I/I- 0.15 C - 1.8 I - 0.5 CS - 0.7	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Exhibit B-2.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
001	Carrollton STP	Kentucky River (0.5)	Ky. 0020265	Prim.	350.4	0.4	120.0	135.0	18.0	DO = 1
321	Timberview Trailer Park	UT-Ky. River		E.A.	0.0	0.0025	35.0	35.0	5.0	
323	Carroll Mobile Home Park	UT-Ky. River		E.A.	0.0	0.0025	40.0	40.0	6.0	

Exhibit B-2.3t Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04001	Carrollton STP	563	0.5	30/125.1	30/125.1	20/83.4	4.0		671 Ca

Alternative Water Quality Management Plans

The City of Carrollton is the largest and only significant discharger in the segment. A primary plant, having a treatment capacity of 0.5 MGD, discharges effluent approximately 0.5 river miles above the confluence of the Kentucky and Ohio Rivers. Present effluent characteristics shown in EXHIBIT B-2.4t are not adequate to meet water quality standards and the equivalent of secondary treatment as defined by state and federal water quality standards. Approximately 59 percent of the total land area within the city boundaries is served with sanitary sewers varying in diameter from 8 inches to 15 inches and are primarily of vitrified clay pipe construction.

A number of the industries presently existing east of Carrollton along U.S. 42, discharge treated effluent into the Ohio River. Private developments presently exist along U.S. 42 east of the city as well as south along U.S. Highway 227 and State Highway 36. Butler State Park, located contiguous to the city boundaries, is served by a 100,000 GPD wastewater plant that discharges an effluent to an unnamed tributary of Segment #002. Carrollton, being the largest municipality within a reasonable distance of the smaller dischargers,provides a sound basis for development of a service area for serving adjacent and nearby publicly and privately owned developments. Consideration should be given to enlargement of the Carrollton service area for wastewater collection and treatment in the 201 Facilities Plan. Such plan should give consideration to serving Prestonville, west of the Kentucky River, as well as the other areas mentioned above, along U.S. Highways 42, 227 and State Highway 36. Pumpage of wastewater from Butler State Park to the collection system of the City of Carrollton should be seriously considered on a cost effective basis. Another alternative to pumpage is set forth in the text of Segment 002. The small treatment plants serving Timberview Trailer Park and Carroll Mobile Home Park should be similarly evaluated on a cost effective basis during 201 Facilities Planning.

SEGMENT #3 ANALYSIS
435.6-4.0/11.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 2.6

Location

Segment #3 extends up the Kentucky River from Lock and Dam #1 (RM 4.0) to the confluence of the Kentucky River and Eagle Creek, (RM 11.0). Segment #3 lies in portions of Carroll, Trimble and Henry Counties.

Basic Planning Data

Segment #3 contains the rural non-farm community of Worthville, 20 square miles of rural Henry County, 38.04 square miles of rural Carroll County and 0.47 squares miles of Trimble County. Worthville's population in 1970 was 258 and is projected to increase only slightly, to 278 by 1995.

Segment #3 contains an estimated 39.8 square miles of agricultural land and 17.5 square miles of forest and woodland.

Exhibit B-3.1t Basic Planning Data

Segment #3	Projection Years			
	1970	1975	1980	1995
Population Total	1,592	1,654	1,717	1,808
Rural	1,592	1,654	1,717	1,808
Farm	1,334	1,391	1,449	1,530
Non-Farm	258	263	268	278
Urban	-	-	-	-
Housing Unit Total	518	554	600	673
Rural	518	554	600	673
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	39.8	39.8	39.8	39.8
Silviculture	17.5	17.5	17.5	17.5
Mining	-	-	-	-
Construction	-	-	-	-
Urban	0.3	0.3	0.3	0.3

Segment Hydrology

The only perennial stream in Segment #3 is the main stem of the Kentucky River with a 7-day, 10-year low flow of 280.3 cfs. There are also two other small tributaries, Whites Run and Mill Creek, that are tributary to the main stem. However, both streams are insignificant and Segment #3 is located in the Hills of the Bluegrass Physiographic Region and contains 58.0 square miles with an upstream drainage area of 6905 square miles. The thalweg slope of the segment is 0.6 feet per mile and the hydraulic slope is 0.0 feet per mile due to impoundment.

Water Quality Data

Segment #3 is classified as an Effluent Limited segment. There is only one significant discharger in the segment, and its effluent is insignificant in comparison to the maximum theoretical daily load of the main stem of the Kentucky River which comprises Segment #3.

Point Source Dischargers

The significant point source is Segment #3 is General Butler State Park. This discharge is located 0.1 miles from the Kentucky River on a renamed tributary. The discharge arises from an Extended Aeration Plant that will not meet effluent standards for the tributary. This discharger is graphically located on EXHIBIT B-1m and its characteristics are tabulated on EXHIBIT B-3.2t.

Non-point Source Dischargers

There are no significant non-point sources in Segment #3 that cause a detrimental effect on water quality.

Waste Load Allocation and Priority

Due to the high flow through the main stem of the Kentucky River under all weather conditions, a T1A treatment level is presently sufficient for any discharge to the main stem. In EXHIBIT B-3.3t, the waste load allocation for General Butler State Park has been tabulated with a proposed T1A treatment

Exhibit B-3.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
002	Gen. Butler State Park	S.E. of Carrollton 435.6-4.5-0.1		E.A.	0.0	0.05	30.0	30.0	1.5	DO = 4.0
101	Anderson Mobile Home Park (Green Acres)	Whites Run Ck.		E.A.	0.0	0.005	30.0	30.0	3.0	
322	Phelps Dodge Aluminum	UT-Ky. River		E.A	0.0	0.004	-	15.0	-	

Exhibit B-3.3t

Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04002	General Butler State Park	78.8	0.07	30/17.5	30/17.5	20/11.7	4.0	6-9 pH	

level even though the present discharge is into a dry stream. The basis for this treatment level is that it is more economical to pipe the effluent one-tenth of a mile to the main stem of the Kentucky River than to provide the treatment necessary to meet requirements of treatment level T1B.

By relocation of the effluent line so that the discharge will be directly into the Kentucky River, General Butler State Park will comply with all applicable water quality standards. The priority for Segment #3 includes the following factors:

Population	1.8
Severity of Pollution	0.8
Non-point sources	0.0
Segment Priority	2.6

Municipal Needs

There are no municipal needs in Segment #3 except as they relate to Segment #2. (See alternative water quality management plan of Segment #2 and this segment).

Alternative Water Quality Plan

The wastewater treatment plant at General Butler State Park will not meet the NH3-N, D.O., or B.O.D., stream standards with its effluent at the present location. Three alternatives are available (1) upgrade its present plant to T4B level and maintain the existing discharge location, However, this does not appear to be a feasible alternative from an economic point of view, (2) pumping to the municipal collection system of the City of Carrollton, thereby eliminating the need for a treatment plant, and (3) piping the effluent 0.1 miles to the Kentucky River thus negating the requirements for additional treatment.

SEGMENT #4 ANALYSIS
435.6-11.0/31.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 340.0

Location

Segment #4 is located on the main stem of the Kentucky River from its confluence with Eagle Creek (RM 11.0) to Lock and Dam #2 (RM 31.0). Segment #4 lies partially in Henry and Owen Counties.

Basic Planning Data

Segment #4 contains the rural non-farm communities of New Castle and Gratz, 110 square miles of rural Henry County and 69 square miles of rural Owen County. The rural non-farm population of the segment was 860 in 1970 and is projected to increase to 1,005 by 1995. The rural farm population in 1970 was 5,925 and is projected to increase to 7,774 by 1995.

New Castle is the principal community in Segment #4 with a 1970 population of 755, projected to increase to 900 by 1995. Two manufacturing plants are located in New Castle. One, Lammer's, Inc.,produces solvent mixes, the other,Meyer's and Son Manufacturing Co., produces men's work clothing.

The rural area of Segment #4 contains 127.4 square miles of agriculture land and 51.4 square miles of forest and woodland.

Exhibit B-4.1t Basic Planning Data

Segment #4	Projection Years			
	1970	1975	1980	1995
Population Total	6,785	7,086	7,469	8,779
Rural	6,785	7,087	7,469	8,779
Farm	5,925	6,206	6,564	7,774
Non-Farm	860	880	905	1,005
Urban	-	-	-	-
Housing Unit Total	2,275	2,444	2,669	3,432
Rural	2,275	2,444	2,669	3,432
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	127.4	127.4	127.4	127.3
Silviculture	51.4	51.4	51.4	51.4
Mining	-	-	-	-
Construction	-	-	-	0.1
Urban	1.0	1.0	1.0	1.1

Classification

The main stem is classified as Effluent Limited due to the extreme high sustained flow and absence of significant wasteloads in the segment. However, there are critical water quality problems in some of the tributaries. Drennon Creek which is the receiving stream for the wastewater discharge of the City of New Castle is severely affected.

Segment Hydrology

Due to the large upstream drainage area and the low flow augmentation effects from impoundments above Segment #4, the flow through the segment is extremely high during all seasons. (A 7-day, 10-year low flow of 280 cfs). Drennon Creek is a major tributary within Segment #4 and has considerable water quality problems due primarily to the lack of flow during most of the dry weather periods. The Kentucky River in Segment #4 has a thalweg slope of 0.4 feet per mile and a hydraulic slope of 0.0 feet per mile due to impoundments. The pool elevation of the Kentucky River in this segment is 427.7 feet (MSL). Four major tributaries lie within the segment, Cane Run, Little Twin Creek, Big Twin Creek and Drennon Creek. Segment #4 has an area of 201.2 square miles and a total upstream drainage area of 5,849.3 square miles.

Water Quality Data

The water quality of the segment is excellent, however there are some critical water quality problems on Drennon Creek during many periods of dry weather when the flow of the stream is zero. There are also four minor dischargers located on Drennon Creek. All have treatment levels equal to secondary or less and will not produce an effluent that will satisfy water quality standards. In addition, the most critical water quality problem is due to the 0.17 MGD discharge of the New Castle STP into Town Branch, a tributary of Drennon Creek. The present plant consists of an Imhoff tank only. Required treatment should be T4B.

Point Source Dischargers

The only significant point source discharge in Segment #4 is the previously mentioned New Castle Wastewater Treatment Plant located 15.1 miles upstream Drennon Creek on Town Branch. A list of all point sources in the segment and their related discharge characteristics in presented in EXHIBIT B-4.2t. The significant dischargers are graphically located on EXHIBIT B-1m.

Non-point Source Dischargers

There are no significant non-point sources in the Kentucky River in Segment #4. Land within the segment is used for agricultural purposes with a major portion in second and third growth timber of little commerical value.

Waste Load Allocation and Priority

There is a medium range priority assigned to Segment #4 (#340.0) due to the critical problem on Drennon Creek centering around New Castle. The present Imhoff tank is producing less than primary level treatment. Water quality modeling has indicated a need for a treatment level of T4B for New Castle to prevent water quality standards violations. The segment priority number was determined using the following factors:

Population	7.8
Severity of Pollution	332.2
Non-point Sources	0.0
Segment Priority	340.0

The construction abatement priority for the City of New Castle is calculated in EXHIBIT B-4.5t.

Exhibit B-4.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
006	New Castle STP	New Castle, Ky. Town Br. 435.6-21.0-11.9-3.4		Prim.	0	0.17	150.0	155.0	18.0	DO = 1.0
102	Monterey Rest & Ser. Sta.	UT-Ky. River		E.A.	0	0.001	32.0	40.0	10.0	
103	Adams House	Kentucky River		E.A.	350.4	0.0015	30.0	35.0	4.0	
104	Perry Park Development	Kentucky River		E.A.	350.4	0.015	30.0	30.0	4.0	
105	New Castle High School	Town Creek-Drennon Creek		E.A.	0.0	0.0075	35.0	35.0	4.0	
106	Eastern Grade School	UT-Drennon Cr.		ST & SF	0	0.004	15.0	5.0	3.0	
107	Henry County Middle School	Town Creek-Drennon Creek		E.A.	0	0.0054	40.0	40.0	5.0	
108	Henry County Rec. Center	Town Creek-Drennon Creek		E.A.	0	0.005	32.0	35.0	4.0	
007	Geoghagan & Mathis	Lockport		Sur.Drain.	347.7	0.3	-	45.0	-	6-9 pH
306	L & D #2	Hgwy. Ditch Kentucky River	Ky. 0020303	E.A.	0	0.0001	20.0	20.0	2.0	
331	Grisham Rest & Ser. Sta.	Monterey UT-Ky. River		E.A.	0	0.001	20.0	20.0	4.0	

Exhibit B-4.3t

Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs. day	Proposed Effluent Characteristics (mg/1 / lbs./day)						
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/1)	Other	Priority
04006	New Castle STP	30.0	0.18	10/15.0	15/22.5	1.0/1.5	8.0		885 Ca

Exhibit B-4.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(New Castle)				
Treatment	.42	4.5	330	623.7
I/I	.083	1.5	330	41.1
Collectors	.333	1.0	330	109.9
Interceptors	.167	2.0	330	110.0
Combined Sew.	-	-	-	-
Total Abatement Priority				885

Exhibit B-4.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(New Liberty)				
Treatment	.50	4.5	10	22.5
I/I	-	-	-	-
Collectors	.40	1.0	10	4
Interceptors	.10	2.0	10	2
Combined Sew.	-	-	-	-
Total Abatement Priority				28

Municipal Needs

The City of New Castle needs to upgrade its Wastewater Treatment facilities sufficiently to produce an effluent quality equal to or less than 10 parts per million of B.O.D., 1 part per million of NH3-N and at least 8 parts per million of D.O. This will require a T4B treatment level. The existing discharge characteristics are tabulated in EXHIBIT B-4.2t.

Alternative Water Quality Management Plan

The City of New Castle is presently conducting a 201 Facility Plan for wastewater treatment facilities. There are no adjacent or near cities than can be incorporated into the New Castle plan on a cost effective basis. The Henry County High School, located just outside the corporate limits of the city, has two small extended "package" plants for treatment of domestic waste. These plants should be abandoned and the wastes pumped into the New Castle system. Another small extended plant of the "package" type serves the Henry County Country Club. This plant likewise should be discontinued within a reasonable period of time after completion of the proposed New Castle plant and the raw waste pumped to the city.

Sufficient land surrounds the city to permit consideration of several alternative treatment methods, including land application of secondary effluent, lagoons, slow and rapid sand filters, and extended aeration. The treatment system should be simple in design, meet water quality objectives, be cost effective and have low maintenance and operational cost. Disposal of plant residuals should be applied to farm land where possible and applicable for use on non-edible crops.

Exhibit B-4.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04006	New Castle STP	T4B / T4B	170 lbs./day	T - 0.25 I/I- 0.05 C - 0.2 I - 0.1	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #5 ANALYSIS
435.6-51.0/42.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 4.4

Location

Segment #5 is located on the main stem of the Kentucky River from Lock and Dam #2 at (RM 31.0) to Lock and Dam #3 at (RM 42.0) plus the related tributaries. Parts of Owen, Franklin, Scott, Henry and Shelby Counties lie in this segment.

Basic Planning Data

Segment #5 contains the rural non-farm communities of Lockport and Monterey and portions of rural Shelby, Henry, Owen, Franklin and Scott Counties. The population of both Lockport and Monterey is projected to remain stable over the next twenty years.

Within Segment #5 is located the small Elmer Davis Recreation Lake and the state owned Kleber Wildlife Area near the rural settlement of Harmony.

The rural portion of Segment #5 contains some 148 square miles of agricultural land and 61 square miles of forest and woodland.

Exhibit B-5.1t Basic Planning Data

Segment #5	Projection Years			
	1970	1975	1980	1995
Population Total	5,237	5,484	5,641	6,354
Rural	4,927	5,174	5,331	6,044
Farm	4,927	5,174	5,331	6,044
Non-Farm	310	310	310	310
Urban	-	-	-	-
Housing Unit Total	1,729	1,863	1,982	2,399
Rural	1,729	1,863	1,982	2,399
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	148.7	148.7	148.7	148.7
Silviculture	61.7	61.7	61.7	61.7
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

There is a high volume of flow through the segment during all weather periods, and there are no significant dischargers within Segment #5. Based on this data, the segment has been classified as Effluent Limited.

Segment Hydrology

The 7-day, 10-year low flow through Segment #5 is 280.3 cfs. This produces an enormous assimilative capacity in the segment in spite of the nearly flat thalweg slope (0.9 feet per mile), and the low hydraulic slope (0.0 feet per mile), due to the navigational system of locks and dams on the main stem of the Kentucky River. The segment is located in the Hills of the Bluegrass Physiographic Region and has an area of 197.8 square miles including three minor tributaries which are: Cedar Creek, Severn Creek, and Six Mile Creek. The total upstream drainage area of the segment is 5651.5 square miles.

Water Quality Data

The water quality in Segment #5 is excellent. There are no significant dischargers within the segment and the waste loads from dischargers located upstream of Segment #5 have been totally assimilated prior to entering the segment. Land use is devoted to agri-

cultural purposes of the small farm type. Much of the land is covered with trees and small groves thus retarding storm run-off.

Point Source Dischargers

There is only one significant point source discharger in Segment #5, graphically located on EXHIBIT B-1m,. There are five insignificant dischargers in this segment, the largest of which has a design flow of only 0.01 MGD. The minor dischargers have no effect on water quality of the segment. EXHIBIT B-5.2t lists all point sources in the segment and their related characteristics.

Non-point Source Dischargers

There are no significant non-point source dischargers in Segment #5. Minor non-point source discharges may occur as a result of agricultural activities, but these have little or no effect on water quality.

Waste Load Allocation and Priority

Since there are no water quality violations and no significant dischargers, the segment is classified as Effluent Limited. The segment priority number is computed using the following factors:

Population	4.4
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	4.4

Municipal Needs

Not applicable to this segment.

Alternative Water Quality Management Plan

Not applicable to this segment.

Exhibit B-5.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
109	Bethany Elem. School	Indian Creek 435.6-41.7		ST & SF	0	0.0021	15.0	5.0	3.0	
110	Owen County Elem. School	Slippery Rock Creek		ST & SF	0	0.01	15.0	5.0	3.0	
307	L & D #3	Kentucky River	Ky. 0020290	E.A.	347.0	0.0001	20.0	20.0	2.0	
333	Pierce Trailer Court	Kentucky River		E.A.	347.7	0.002	30.0	35.0	4.0	
334	T.E. Moore (Resident)	UT-Six Mile Cr.-Ky. River		E.A.	0.0	0.0015	30.0	35.0	4.0	

Exhibit B-5.3t Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs. day	Proposed Effluent Characteristics (mg/l / lbs./day)						
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	Priority
04007	Geohagan & Mathis	-	0.3	-	30/75.1	-	-	6-9 pH	-

Exhibit B-5.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Monterey)				
Treatment	.444	1.5	4.4	2.93
I/I	-	-	-	-
Collectors	.444	1.0	4.4	1.95
Interceptors	.111	2.0	4.4	.98
Combined Sew.	-	-	-	-
Total Abatement Priority				6

Exhibit B-5.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
-	Monterey	T4B T4B	41 lbs./day	T - 0.2 I/I- 0 C - 0.2 I - 0.05	1977
(No treatment or collection system presently existing.)					

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #6 ANALYSIS
435.6-42.0/51.9

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 2.0

Location

Segment #6 spans the main stem of the Kentucky River from Lock and Dam #3 to the confluence point of the Kentucky River and Elkhorn Creek. This is a segment length of 9.9 miles, (RM 42.0 to RM 51.9).

Basic Planning Data

Segment #6 contains portions of rural Franklin, Owen and Henry Counties. The segment is characterized by small, rural settlements including Polsgrove, Flag Fork, Swallowfield and Ottisville, none of which is expected to show significant growth during the next twenty years.

An estimated 30.7 square miles of the segment is agricultural land while the remaining 15.9 square miles is characterized by woodland and forest.

Exhibit B-6.1t Basic Planning Data

Segment #6	Projection Years			
	1970	1975	1980	1995
Population Total	2,227	2,206	2,089	1,641
Rural	2,227	2,206	2,089	1,641
Farm	2,227	2,206	2,089	1,641
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	712	730	714	613
Rural	712	730	714	613
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	30.7	30.7	30.7	30.7
Silviculture	15.9	15.9	15.9	15.9
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

There are no significant dischargers in the segment and an extremely high flow during all periods. Segment #6 is therefore classified as an Effluent Limited segment.

Segment Hydrology

The main stem of the Kentucky River has a 7-day, 10-year low flow of 280.3 cfs, plus the 29.1 cfs contribution of Elkhorn Creek from upstream dischargers. (Segments #15, #16, #17 and #18) Segment #6 lies predominately in the Hills of the Bluegrass Physiographic Region with its upper end in the Inner Bluegrass Region. The main stem of the Kentucky River has a thalweg slope of 0.5 feet per miles and a hydraulic slope of 0.0 feet per mile due to impoundments. The pool elevation is 454.3 feet MSL. Segment #6 has an area of 46.6 square miles and a total upstream drainage area of 5,604.9 square miles including Elkhorn Creek.

Water Quality Data

Water quality problems do not presently exist in Segment #6. The heavy waste load discharged into Elkhorn Creek in Segment #16 and #17 has been assimilated by the time the discharges reach the Kentucky River main stem at RM 52.10 . The City of Frankfort discharges into Segment #12 located immediately upstream of Segment #6. The oxygen sag that results in Segment #12 as a result of this discharge carries over into Segment #6 using 7-day, 10-year, low flow criteria, however, the dissolved oxygen sag does not violate water quality standards of 5 parts per million. Facility Planning is being accomplished for the City of Frankfort. Completion of the construction of this project will eliminate the oxygen sag carry over into the segment.

Point Source Dischargers

Segment #6 contains no significant point source dischargers.

Non-point Source Dischargers

There are no significant non-point dischargers in Segment #6. However, non-point dischargers that occur in Segment #12, immediately upstream, could have a slight impact on water quality in Segment #6 during periods of minimum river flow and high extensive rainfall. This would cause the discharge of street wash and combined sewer overflows in the City of Frankfort.

Waste Load Allocation and Priority

The population of Segment #6 is the only contributing factor to the segment priority since there are no dischargers located in this segment. The segment priority is 2.0 calculated as follows:

Population	2.0
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	2.0

Municipal Needs

There are no municipalities in the segment, however, municipal needs of the immediate upstream segment (#12) will have some impact on this segment.

Alternative Water Quality Management Plan

Completion of construction of secondary wastewater treatment facilities for the City of Frankfort will enhance water quality in the segment during periods of low flow. Secondary treatment facilities for the City of Frankfort are expected to be completed by July 1, 1977.

SEGMENT #7 ANALYSIS
435.6-11.0-0/34.6

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 3.5

Location

Segment #7 is located on Eagle Creek from its confluence with the Kentucky River (RM 11.0) to the junction of Eagle Creek and Clarks Creek (RM 34.6). This segment is located in portions of Gallatin, Carroll, and Owen Counties.

Basic Planning Data

Segment #7 contains the rural non-farm Carroll County communities of Sanders and Sparta along with portions of rural Carroll, Owen, and Gallatin Counties. Sanders' population in 1970 was 268 and is expected to increase slightly, to 393 by 1995. Sparta's population in 1970 was 168 and is expected to remain stable through the planning period.

Segment #7 contains an estimated 80.5 square miles of agricultural land and 39.3 square miles of forest and woodland.

Exhibit B-7.1t Basic Planning Data

Segment #7	Projection Years			
	1970	1975	1980	1995
Population Total	3,009	3,178	3,520	3,768
Rural				
Farm	2,573	2,717	3,034	3,207
Non-Farm	436	461	486	561
Urban	-	-	-	-
Housing Unit Total	989	1,063	1,243	1,360
Rural	989	1,063	1,243	1,360
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	80.5	80.4	80.3	80.0
Silviculture	39.3	39.3	39.3	39.3
Mining	-	-	-	-
Construction	-	0.1	0.1	0.3
Urban	1.4	1.5	1.6	1.9

Classification

Due to heavy wastewater discharges upstream of the segment, and a no flow condition on a 7-day, 10-year basis, the segment has been classified as Water Quality Limited.

Segment Hydrology

Eagle Creek has a stream average slope of 5.0 feet per mile in Segment #7. The major tributary within the segment is Brush Creek and like Eagle Creek is dry during the dry seasons. Physiographically Segment #7 lies in the Hills of the Bluegrass Region. Segment #7 contains 128.8 square miles and has an upstream drainage area of 381.4 square miles.

Water Quality Data

Water quality data is sparse, however, water quality modeling indicated a slight D.O. sag in the upper reaches of the segment due to upstream discharges. It should be pointed out that water quality management strategies make provision for the establishment of a primary water quality monitoring station on Eagle Creek near stream mile 22.4. The installation of this monitoring station will provide the required data to properly evaluate stream characteristics in the future.

Point Source Dischargers

There are no significant point source dischargers within the segment. Insignificant point sources are shown on EXHIBIT B-7.2t.

Non-point Source Dischargers

Due to poor farming practices and topographical conditions, some siltation occurs, however, water quality in the segment is not significantly affected from these sources.

Waste Load Allocation and Priority

Since there are no significant dischargers in the in the segment, this section is not applicable. The segment priority is a function of population and was calculated using the following factors:

Population	3.5
Non-point Sources	0.0
Severity of Pollution	0.0
Segment Priority	3.5

Municipal Needs

201 Facilities Plans have been proposed for the Cities of Sparta and New Liberty. In the event of construction of these wastewater treatment facilities a T4B treatment level will be necessary to meet the NH3-N requirements.

Alternative Water Quality Management Plans

During the 201 Facilities Planning process, due consideration should be given to one common treatment facility to serve Sparta and Sanders. Treatment processes considered should be land application following a lagoon or installation of an extended aeration plant followed by sand filtration and chlorination.

In the event of construction of the proposed Eagle Creek Dam, low flow augmentation may influence the required treatment level for dischargers below the dam site.

Exhibit B-7.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
143	Shellup's Beauty Shop	Brush Creek		E.A.	0	0.0005	40.0	35.0	4.0	
317	Valley Haven Rest Home	Eagle Creek		E.A.	0	0.007	35.0	35.0	4.0	
318	Humber Oil Service Sta.	UT-Lost Branch Eagle Creek		E.A.	0	0.0015	35.0	25.0	3.0	
319	Glenco Grade School	Eagle Creek		E.A.	0	0.0017	30.0	30.0	4.0	
320	Williamstown Elem. School	Eagle Creek		E.A.	0	0.0011	30.0	30.0	4.0	

Exhibit B-7.3t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Sparta-Sanders)				
Treatment	.286	1.5	2.9	1.2
I/I	-	-	-	-
Collectors	.570	1.0	2.9	1.6
Interceptors	.143	2.0	2.9	0.8
Combined Sew.	-	-	-	-
Total Abatement Priority				4

Exhibit B-7.4t Municipal Needs*

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
-	Sanders-Sparta	T1A / T1A	80.8 lbs./day	T - 0.3 I/I- 0 C - 0.6 I - 0.15	1977
(No treatment or collection system presently existing.)					

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #8 ANALYSIS
435.6-11.7-27.4-0.0

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 2.7

Location

Segment #8 begins at the confluence of Eagle Creek and Ten Mile Creek (RM 0.0) to the headwaters of Ten Mile Creek and its tributaries. Portions of this segment lie in Gallatin, Boone and Grant Counties.

Basic Planning Data

Segment #8 is comprised of the Grant County rural non-farm community of Crittenden and protions of rural Grant, Boone and Gallatin Counties. Crittenden's population in 1970 was 236 and is expected to remain stable through the planning period. Population of the segment in 1975 was estimated to be 2,684 and is expected to increase slightly, to 2,948 by 1995.

Located within Segment #8 are two recreational lakes, Bullock Pen Lake and Boltz Lake.

Of the 72.28 square miles in Segment #8, an estimated 53.4 square miles is devoted to agriculture and 18.7 square miles is in forest and woodland.

Exhibit B-8.1t Basic Planning Data

Segment #8	Projection Years			
	1970	1975	1980	1995
Population Total	2,639	2,684	2,786	2,948
Rural	2,639	2,684	2,786	2,948
Farm	2,403	2,448	2,550	2,712
Non-Farm	236	236	236	236
Urban	-	-	-	-
Housing Unit Total	825	855	910	1,026
Rural	825	855	910	1,026
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	53.4	53.4	53.4	53.4
Silviculture	18.7	18.7	18.7	18.7
Mining	-	-	-	-
Construction	-	-	-	-
Urban	0.2	0.2	0.2	0.2

Classification

Due to the 7-day, 10-year no flow condition and numerous small wastewater dischargers, the segment has been classified as Water Quality Limited.

Segment Hydrology

Ten Mile Creek and its major tributary, Arnold's Creek, both have impoundments near their headwaters. Bullock Pen Lake serves as a source of public water supply and has a surface area of 134 acres, and a volume of 2,464 acre feet. Boltz Lake, located on Arnold's Creek, has a surface area of 92 acres and a volume of 2,168 acre feet. Neither lake provides low flow augmentation during dry weather periods.

The average slope of Ten Mile Creek is 17.8 feet per mile. Land use in the segment is predominately agricultural and lies within the Hills of the Bluegrass Physiographic Region, with an area of 68.33 square miles.

Water Quality Data

Although water quality data is sparse for this segment, restrictions on the location of wastewater discharge above public water supply source by the Department of Natural Resources and Environmental Protection Agency would guarantee high quality water in the impoundments. Numerous small dischargers are located on Ten Mile Creek. The accumulation efforts of these discharges degrade water quality in the segment, particularly during dry weather periods. Crittenden, Kentucky is located just south of Bullock Pen Lake. Drainage related to septic tank overflow problems and urban run-off enter Kittle Run, a tributary of Ten Mile Creek. This waste load source also contributes to degradation of Ten Mile Creek.

Point Source Dischargers

The dischargers located within Segment #8 are listed in EXHIBIT B-8.2t, however none of these is significant.

Non-point Source Dischargers

Run-off from the City of Crittenden as related to septic tank failures and storm water run-off are the principal contributors to source discharges, however, they are not considered to have a significant effect on water quality within the segment.

Waste Load Allocation and Priority

There are no significant dischargers within the segment and the accumulative effect of all minor dischargers in the segment is 64.3 pounds of total oxygen demand. The segment priority was determined using the following factors:

Population	2.7
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	2.7

Municipal Needs

At the present time there are no municipal wastewater treatment facilities within the segment, however, a 201 Facilities Plan has been designed for the City of Crittenden. Should construction of wastewater treatment facilities become a reality, a treatment level of T4B will be required. EXHIBIT 8.3t indicates costs related to construction of the facilities.

Alternative Water Quality Management Plan

In the event of construction of wastewater collection and treatment facilities for the City of Crittenden, consideration should be given to locating the discharge out of the drainage basin of Bullock Pen Lake and Boltz Lake. Land application of the treated effluent should be considered on a cost effective basis and all small dischargers should be included in the comprehensive system where feasible.

Exhibit B-8.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/1				
						Flow (mgd)	BOD	SS	NH3-N	Other
144	Mullins Wildlife Management	Pond- Ten Mile Creek		E.A.	0	0.001	45.0	45.0	6.0	
145	Standard Service Sta.	Ky-491 & I-71 Trib. Bullock Pen Res.		ST & SF	0.0	0.0009	20.0	35.0	4.0	
146	Eagle Creek Country Club	Tributary-Ten Mile Creek		E.A.	0	0.04	35.0	40.0	8.0	
147	Gulf Oil Ser. Station Ky 1548-I-75	Trib. Bullock Pen Res.		E.A.	0	0.0015	25.0	30.0	4.0	
148	Kampgrounds of America	Ten Mile Creek		E.A.	0	0.005	35.0	35.0	6.0	
149	Simpson Trailer Park	Ten Mile Creek		E.A.	0	0.0025	40.0	40.0	8.0	
328	Standard Oil Service Sta.	Ten Mile Creek		E.A.	0	0.001	25.0	25.0	4.0	
151	Tressler Oil Company	Clay Lick		E.A.	0.0	0.001	20.0	30.0	4.0	
385	Shell Oil Service Sta.	Trib.-Clay Lick		E.A.	0	0.001	20.0	30.0	4.0	
152	Mt. Zion Elem. School	Ten Mile Creek		ST & SF	0.0	0.0017	30.0	30.0	4.0	
324	Telstar Motel & Park	Jack Lick-Clark's Run		E.A.	0.0	0.0015	30.0	30.0	4.0	

Exhibit B-8.3t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Crittenden)				
Treatment	.385	4.5	2.7	4.7
I/I	-	-	-	-
Collectors	.462	1.0	2.7	1.2
Interceptors	.154	2.0	2.7	0.8
Combined Sew.	-	-	-	-
Total Abatement Priority				7

Exhibit B-8.4t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
-	Crittenden	T4B / T4B	47.2 lbs./day	T - 0.25 I/I- 0 C - 0.3 I - 0.1	1977

(No treatment or collection system presently existing.)

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #9 ANALYSIS
435.6-11.7-34.6-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 35.0

Location

Segment #9 begins at the confluence of Eagle Creek and Clark's Creek (RM 34.6) and extends to the headwaters of Clark's Creek and its tributaries. Portions of Gallatin, Boone, Grant, and Kenton Counties are located in this segment.

Basic Planning Data

Segment #9 contains the Grant County rural non-farm communities of Williamstown and Dry Ridge, and 23.3 square miles of rural Grant County. The population of the segment was estimated to be 4,205 in 1975 and is projected to increase to 5,346 by 1995. Williamstown's population was 2,063 in 1970 and is projected to increase to 2,750 by 1995. The population of Dry Ridge was 1,180 in 1970 and is projected to increase to 1,650 by 1995.

Principal manufacturing employers include Phillips Products Company, Inc. with 40 employees producing plastic pipe and Sunn Musical Equipment Company, manufacturer of amplifier and speaker equipment.

In 1975, land use in Segment #9 contained 17.4 square miles of agricultural land and 5.9 square miles of woodland and forest.

Exhibit B-9.1t Basic Planning Data

Segment #9	Projection Years			
	1970	1975	1980	1995
Population Total	3,974	4,205	4,443	5,346
Rural	3,974	4,205	4,443	5,346
Farm	811	824	843	946
Non-Farm	3,163	3,381	3,600	4,400
Urban	-	-	-	-
Housing Unit Total	1,302	1,411	1,532	1,980
Rural	1,302	1,411	1,532	1,980
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	17.9	17.4	16.8	14.7
Silviculture	5.9	5.9	5.9	5.9
Mining	-	-	-	-
Construction	-	0.5	0.6	2.1
Urban	8.5	9.0	9.6	11.7

Classification

A Water Quality Limited classification has been assigned the segment based on zero stream flows during the dry weather seasons, the significant discharger of Williamstown and numerous insignificant dischargers.

Segment Hydrology

Segment #9 is located in the Hills of Bluegrass Physiographic Region. The average stream slope of the segment is 18.5 feet per mile which will enhance natural reaeration considerably. Land use is primarily agricultural in nature, except for the urban areas of the cities of Williamstown and Dry Ridge. The segment area contains 32.30 square miles and is located in the Hills of Bluegrass Physiographic Region.

Water Quality Data

Water quality data in the segment is very sparce. The primary water quality monitoring station to be located in Segment #9 will provide future data for assessment of water quality. In addition, the municipal wastewater treatment plant for the City of Williamstown will be required to provide in-plant monitoring that will in turn provide an indication of water quality in Clark's Run. Test records indicate that the present wastewater treatment plant is removing in excess of 90% B.O.D. and S.S.

Point Source Dischargers

The only significant point source discharge in the segment is the City of Williamstown. There are seven minor point source discharges, most of these are located on unnamed tributaries of Clark's Creek. Existing discharge characteristics are listed in EXHIBIT B-9.2t.

Non-point Source Dischargers

The Cities of Williamstown and Dry Ridge contribute urban run-off along with overflows from malfuctioning septic tanks. These discharges are insignificant with respect to water quality.

Waste Load Allocation and Priority

EXHIBIT B-9.3t indicates that a maximum daily T.O.D. load of 50 pounds per day has been allocated to the City of Williamstown. The priority of segment #9 is computed using the following factors:

Population	4.2
Severity of Pollution	30.8
Non-point Sources	0.0
Segment Priority	35.0

Municipal Needs

Due to the low flow conditions of the receiving stream, Williamstown will of necessity, be required to provide a treatment level of T4B. In addition, extensions of the existing collection system are needed along U.S. 25 north of the city and west of U.S. 25. According to information taken from plans prepared for the Northern Kentucky Area District in 1973, the city will require 18,000 feet of sewers and 3,465 feet fo force mains, 2 lift stations and 66 manholes by 1996.

Dry Ridge is located on U.S. 25 approximately one and one half miles north of Williamstown. It does not presently have a comprehensive wastewater collection and treatment system. Malfunctions of septic tanks and improperly treated minor discharges are prevalent in and adjacent to the city. A comprehensive wastewater collection and treatment system is needed. Both cities, Williamstown and Dry Ridge, are programmed to conduct 201 Facility Planning. It is recommended that both cities be included in the same 201 study because of the close location to one another. (See alternative water quality management plan).

Exhibit B-9.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
003	Williamstown STP	Steam Mill Br.		E.A.	0.0	0.30	30.0	30.0	1.4	
336	Dry Ridge Convalescent Home	Trib.-Clay Cr.		E.A.	0.0	0.010	40.0	40.0	8.0	
163	Mehl Manufacturing	Mill Branch		E.A.	0.0	0.0035	30.0	30.0	4.0	
164	Sun Oil Service Sta.	UT-Clark's Cr.		E.A.	0.0	0.006	30.0	30.0	4.0	
165	Bates Motel	UT-Clark's Cr.		E.A.	0.016	0.004	25.0	30.0	4.0	
166	Marathon Oil & Restaurant	UT-Clay Lick		E.A.	0.0	0.012	20.0	30.0	3.0	
167	Williamstown Municipal Housing Site B	Williams Branch		E.A.	0.0	0.0075	40.0	35.0	4.0	
168	Piles Motel	UT-Clark's Cr.		E.A.	0	0.010	35.0	30.0	4.0	
150	Standard Oil Service Sta.	Clark's Run		E.A.		0.001	30.0	30.0	4.0	
327	New Williamstown High School	Steam Mill Br.		E.A.	0	0.0025	35.0	30.0	4.0	
377	Grant County Hospital	UT-Steam Mill Branch		E.A.	0.0	0.005	30.0	30.0	4.0	

Exhibit B-9.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/1 / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/1)	Other	
04003	Williamstown STP	50.0	0.3	10/25	15/37.5	1.0/2.5	8.0	6-9 pH	44 Ca

Exhibit B-9.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Williamstown)				
Treatment	.182	4.5	25	20.5
I/I	-	-	-	-
Collectors	.682	1.0	25	17.0
Interceptors	.136	2.0	25	6.8
Combined Sew.	-	-	-	-
Total Abatement Priority				44

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Dry Ridge)				
Treatment	.0	-	-	-
I/I	-	-	-	-
Collectors	.789	1.0	10	7.9
Interceptors	.211	2.0	10	4.2
Combined Sew.	-	-	-	-
Total Abatement Priority				12

Exhibit B-9.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04003	Williams-town STP	T4B / T4B	550 lbs./day	T - 0.4 I/I- 0 C - 1.5 I - 0.3	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

There appears to be at least four alternative water quality management plans for the Williamstown - Dry Ridge area:

(1) Construction of separate facilities for each city.

(2) Construction of a T4B treatment facility at Williamstown and pumping the wastewater originating in Dry Ridge to this plant.

(3) Constructing a T4B treatment plant at Dry Ridge and pumping the wastewater originating in Williamstown to Dry Ridge for treatment.

(4) Construction of one plant between the two cities to serve the needs of both.

Two distinct advantages stand out for alternative 2. The City of Williamstown already has in operation a secondary treatment facility, whereas Dry Ridge does not. Using a system of pressure and gravity sewers numerous small point source discharges existing between Dry Ridge and Williamstown could be included in a regional system.

These alternatives should be evaluated during 201 Facility Planning with due regard to cost effectiveness.

SEGMENT #10 ANALYSIS
435.6-11.0-34.6/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 83.0

Location

Segment #10 is located on the main stem of Eagle Creek beginning at the confluence of Clark's Creek and Eagle Creek (RM 34.6) and extending to the headwaters of Eagle Creek and its tributaries. Portions of Scott, Owen, and Grant Counties are within the segment boundaries.

Basic Planning Data

Segment #10 contains the Grant County rural non-farm community of Corinth, the Scott County rural non-farm community of Sadieville and numerous small rural settlements. Corinth's population was 359 in 1970 and is expected to increase to 450 by 1995. Sadieville's population in 1970 was 272 and is expected to remain stable during the planning period.

Within Segment #10 are located three recreation lakes: Elk Lake, Timber Wood Lake, and Corinth Lake. In addition, the University of Kentucky operates an agricultural experimentation station in the segment near Sweet Owen, Kentucky. There are no major manufacturing employers located within the segment.

Segment #10 contains an estimated 186.7 square miles of agricultural land and 61.5 square miles of forest and woodland.

Exhibit B-10.1t Basic Planning Data

Segment #10	Projection Years 1970	1975	1980	1995
Population Total	6,798	6,924	7,074	7,518
Rural	6,798	6,924	7,074	7,518
Farm	6,167	6,268	6,392	6,796
Non-Farm	631	656	682	722
Urban				
Housing Unit Total	2,184	2,244	2,345	2,630
Rural	2,184	2,244	2,345	2,630
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	186.7	186.7	186.7	186.7
Silviculture	61.5	61.5	61.5	61.5
Mining	-	-	-	-
Construction	-	-	-	-
Urban	0.9	0.9	0.9	0.9

Classification

Due to the 7-day, 10-year zero flow conditions and the effluent discharged into the segment, the segment has been classified as Water Quality Limited.

Segment Hydrology

The drainage area within the segment contains 250.82 square miles and is located in the Inner Bluegrass and Hills of the Bluegrass Physiographic Regions. Land use is primarily agricultural in nature. The average slope of the stream segment is 3.4 feet per mile.

Water Quality Data

Water quality data is sparse within the segment, however, information taken from Storet information indicates average values for stream water quality as follows: temperature 64°F, specific conductance 372.4, D.O. 7.81 mg/1, pH 7.6, total solids 423.8mg/1 NH3-N 0.08 mg/1, nitrates plus nitrates 0.9 mg/1. phosphorus 0.04 mh/1, total coliform organisims 5,267 per 100 ml.

Point Source Dischargers

There is one significant point source discharge within the segment. The Delaplain Motel Complex lies outside the segment boundary, however, the discharge point is in the Eagle Creek watershed. All discharges in the segment are presented on EXHIBIT B-10.2t. See EXHIBIT B-1m for effluent discharge location of Delaplain Motels.

Non-point Source Dischargers

Non-point source discharges are insignificant, consisting of drainage from agricultural operations. The small cities of Corinth and Sadieville do not have central wastewater collection facilities, consequently some insignificant discharges do occur as the result of malfunctioning septic tank systems.

Exhibit B-10.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/1				
						Flow (mgd)	BOD	SS	NH3-N	Other
005	Delaplain Motels	Little Eagle Creek		E.A.	0.0	0.6	30.0	30.0	2.0	
153	Sun Oil Service Sta.	Trib.-Lake-No. Rays Fork		E.A.	0.0	0.0001	20.0	30.0	4.0	
154	Three Springs Overnight	Trib.-North Rays Fork		E.A.	0.0	0.005	35.0	40.0	8.0	
155	Elk Lake Development	Elk Lake		E.A.	0.0	0.0015	20.0	20.0	4.0	
156	Standard Service Sta.	UT-Little Eagle Creek		E.A.	0.0	0.001	20.0	30.0	4.0	
157	Edward Carr	UT-Little Eagle Creek		E.A.	0.0	0.0005	25.0	30.0	4.0	
158	Triport Disposal Co.	Little Eagle Creek		E.A.	0	0.04	30.0	30.0	4.0	
326	Corinth Elem. School	UT-Rags Fork-Eagle Creek		E.A.	0.0	0.0075	35.0	35.0	4.0	
329	Cook Brothers RECC	UT-Eagle Creek		E.A.	0.0	0.001	-	-	-	
330	Recreation Area	Eagle Creek		E.A.	1.5	0.0015	20.0	25.0	4.0	
332	Gulf Oil Service Sta.	UT-Eagle Creek		E.A.	0.0	0.001	25.0	25.0	3.0	

Waste Load Allocation and Priority

The maximum daily T.O.D. load to the segment from significant dischargers is 100.1 pounds per day, (See EXHIBIT B-10.3t). The segment priority was calculated using the following factors:

Population	6.9
Severity of Pollution	76.1
Non-point Sources	0.0
Segment Priority	83.0

EXHIBIT B-10.4t computes the construction abatement priorities for new facilities in the unsewered cities of Corinth and Sadieville.

Municipal Needs

Due to the lack of municipalities in the segment, there are no municipal needs relative to wastewater facilities. The small cities of Corinth and Sadieville have schedules for 201 Facilities Planning. Hydrological characteristics previously discussed would necessitate a T4B treatment level. Municipal needs and the associated costs for Corinth and Sadieville are tabulated in EXHIBIT B-10.5t.

Alternative Water Quality Management Plan

Any water quality management plan would of necessity have to relate to the small cities of Corinth and Sadieville. The distance between the two cities and the sparse population would preclude regionalization of wastewater collection and treatment facilities.

Exhibit B-10.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04005	Delaplain Motels	100.1	0.6	10/50.0	15/75.1	1.0/5.0	8.0	6-9 pH	

Exhibit B-10.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Cornith)				
Treatment	.400	4.5	49	88.2
I/I	-	-	-	-
Collectors	.474	1.0	49	23.2
Interceptors	.125	2.0	49	12.4
Combined Sew.	.125	-	-	-
Total Abatement Priority				123

Exhibit B-10.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Stamping Ground)				
Treatment	.381	4.5	34	58.3
I/I	-	-	-	-
Collectors	.476	1.0	34	16.2
Interceptors	.143	2.0	34	9.7
Combined Sew.	-	-	-	-
Total Abatement Priority				84

Exhibit B-10.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
-	Corinth	T4B / T4B	90 lbs./day	T - 0.38 I/I- 0 C - 0.45 I - 0.12	-
(No treatment or collection system presently existing)					
-	Stamping Ground	T4B / T4B	95 lbs./day	T - 0.4 I/I- 0 C - 0.5 I - 0.15	-
(No treatment or collection system presently existing.)					

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #11 ANALYSIS
435.6-11.0-38.8-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIROTIY 93

Location

Segment #11 lies in portions of Owen and Grant Counties and contains the drainage basin of Steven's Creek from its confluence with Eagle Creek (RM 38.8) to the headwaters of Steven's Creek.

Basic Planning Data

Segment #11 encompasses the Owen County rural non-farm community of Owenton along with portions of rural Owen and Grant Counties.

Owenton, the principal community in Owen County, had a population of 1,280 in 1970 and is expected to increase to 1,445 by 1995. Major employers in Owenton include Kraft Foods Division, which employs 29 people in the manufacture of cheese and Scholl, Inc., which employs 60 persons in the manufacture of sandals.

The rural sectors of Segment #11 are comprised of 19.3 square miles of agricultural land and 9.7 square miles of forest and woodland.

Classification

Since Steven's Creek has no flow during dry weather periods and receives a relatively heavy waste load from the City of Owenton, it has been classified as Water Quality Limited.

Segment Hydrology

Physiographically, Segment #11 lies in the Hills of the Bluegrass Region and contains 29.9 square miles. The 7-day, 10-year low flow of Stevens Creek is zero.

Water Quality Data

There is no water quality data available on Steven's Creek, however, the water quality model shows violations of dissolved oxygen and ammonia in the stream during low flow periods.

Point Source Dischargers

The only significant point source discharge in Segment #11 is the Owenton wastewater treatment plant. This discharger is graphically located on EXHIBIT B-1m. All point sources in the segment and their related characteristic are shown on EXHIBIT B-11.2t.

Exhibit B-11.1t — Basic Planning Data

Segment #11	Projection Years 1970	1975	1980	1995
Population Total	1,833	1,874	1,915	2,053
Rural	1,833	1,874	1,915	2,053
Farm	553	561	570	608
Non-Farm	1,280	1,313	1,345	1,445
Urban	-	-	-	-
Housing Unit Total	626	663	704	786
Rural	626	663	704	786
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	19.3	19.3	19.3	19.3
Silviculture	9.7	9.7	9.7	9.7
Mining	-	-	-	-
Construction	-	-	-	-
Urban	1.0	1.0	1.0	1.1

Exhibit B-11.2t — Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l Flow (mgd)	BOD	SS	NH3-N	Other
004	Owenton STP	Stevens Creek		T.F.	0	0.150	40.0	40.0	18.0	
159	Jonesville Rest Home	UT-Stevens Cr.		E.A.	0	0.003	40.0	40.0	3.0	
160	Owen County High School	UT-Stevens Cr.		E.A.	0	0.0075	40.0	40.0	4.0	
161	Thomas Motel	UT-Stevens Cr.		E.A.	0	0.001	35.0	35.0	4.0	
162	Smith House Restaurant	UT-Stevens Cr.		E.A.	0	0.001	45.0	30.0	8.0	
328	Glenwood Farms	Mill Creek		E.A.	0	0.0015	45.0	30.0	4.0	
179	Kraft Foods	Spray Irrigation		S.I.	0	-	-	-	-	

Exhibit B-11.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day) Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	Priority
04004	Owenton STP	25.0	0.15	10/12.5	15/18.8	1.0/1.3	8.0	6-9 pH	26 Ca

Non-point Source Dischargers

There is some agricultural run-off in the segment, but this does not cause a significant effect on water quality in the basin.

Waste Load Allocation and Priority

The waste load allocation for the Owenton wastewater treatment facility has been set at 25 pounds of T.O.D. per day. A breakdown of this allocation is shown on EXHIBIT B-11.3t. A priority of 93 has been computed for Segment #11 using the following factors:

Population	1.9
Severity of Pollution	91.1
Non-point Sources	0.0
Segment Priority	93.0

The computation of the construction abatement priority for facilities in Owenton is shown on EXHIBIT B-11.4t.

Exhibit B-11.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Owenton)				
Treatment	.476	4.5	93	199.2
I/I	.127	1.5	93	17.7
Collectors	.317	1.0	93	29.5
Interceptors	.079	2.0	93	14.8
Combined Sew.	-	-	-	-
Total Abatement Priority				261

Municipal Needs

The present 0.15 M.G.D. trickling filter plant at Owenton is not sufficient to produce an effluent that will preserve water quality in Steven's Creek. There is excessive inflow/infiltration in the existing collection system. Additionally, the collection system must be expanded to serve another 200 people by 1995. EXHIBIT B-11.5t shows the municipal needs of Owenton and their related costs.

Exhibit B-11.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04004	Owenton STP	T4B T4B	289 lbs./day	T - 0.3 I/I- 0.08 C - 0.2 I - 0.05	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

In the current 201 Facilities Plan for Owenton, due consideration must be given to the various treatment technologies for upgrading the existing plant to a T4B treatment level, including land disposal, multi-stage trickling filters and filtration. An effort should also be made to reduce excessive inflow/infiltration.

SEGMENT #12 ANALYSIS
435.6-52.1/65.0

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 4600

Location

Segment #12 is located on the main stem of the Kentucky River from its confluence with Elkhorn Creek at River Mile 51.9 to Lock and Dam #4 at River Mile 65.0. This segment includes the North Frankfort area and contains the discharge of the Frankfort wastewater treatment plant. Segment #12 lies in Franklin County.

Basic Planning Data

Segment #12 contains 24.2 square miles of Franklin County, including a portion of the City of Frankfort. The population of the segment was estimated to be 4,175 in 1975 with the urban population accounting for more than half the total. By 1995 the population of the segment is projected to increase to 5,212, of which 4,021 will be categorized urban residents.

The urban area of Segment #12 encompasses approximately 0.8 square miles and is projected to increase to 1.3 square miles by 1995. Located within the sector of the segment is the State Capitol Building, a number of State office buildings and the Kentucky State College. A limited amount of residential development is expected to occur in the future in and around the Indian Hills Subdivision.

Most of the manufacturing activity in the City of Frankfort is located in Segment #12 and includes:

- Bendix Westinghouse, Air Brake Division (Air Brake Components) 303 employees.
- Genesco, Incorporated - 307 employees (men's shoes)
- Ken Wil, Incorporated - 211 employees (ignition transformers, hydraulic pumps, valves)
- National Distillers Products, Inc., - 763 employees (whiskey, feed)
- H. K. Porter Company, Incorporated - 372 employees (automotive appliance trim, metal stamping, roll forming)
- Frank F. Taylor Company - 102 employees (strollers, playpens, high chairs)
- Trigometer, Incorporated - 100 employees (thermal temperature control devices, emissions control devices, electric range components)
- 21 Brands Division of Foremost McKesson, Incorporated - 122 employees (Whiskey)
- Union Underwear Company, Incorporated - 847 employees (men's underwear)

Within the rural sector of Segment #12, an estimated 15 square miles are in agriculture and 8.5 square miles in forest and woodland.

Exhibit B-12.1t — Basic Planning Data

Segment #12	Projection Years 1970	1975	1980	1995
Population Total	3,939	4,175	4,415	5,212
Rural	1,803	1,774	1,655	1,191
Farm	1,803	1,774	1,655	1,191
Non-Farm	-	-	-	-
Urban	2,136	2,401	2,760	4,021
Housing Unit Total	1,263	1,385	1,569	2,242
Rural	578	595	633	758
Urban	685	790	936	1,484
Land Use (Sq. Mi.)	24.2	24.2	24.2	24.2
Rural	23.5	23.4	23.3	22.9
Agriculture	15.0	14.9	14.8	14.4
Silviculture	8.5	8.5	8.5	8.5
Mining	-	-	-	-
Construction	-	0.1	0.1	0.4
Urban	0.7	0.8	0.9	1.3

Classification

Segment #12 has been classified as Water Quality Limited due to a variety of water quality problems including inadequate treatment of the municipal waste, industrial waste and non-point source discharges.

Segment Hydrology

The main stem of the Kentucky River has a 7-day, 10-year low flow of 280 cfs, that results in a rather large assimilative capacity. There are no major tributary streams in the segment. Penitentiary Run is a small tributary that enters the Kentucky River at River Mile 64.5 and contains the effluent of one significant discharger, Schenley Distillery, (Discharger #24). Twenty-nine miles are included in the segment area and the drainage area upstream of the segment is 5,079 square miles. The thalweg slope of the main stem of the Kentucky River within the segment is 0.8 feet per mile and the hydraulic slope is 0.0 feet per mile due to impoundments. Pool elevation within the segment in 454.33 feet (MSL). Physiographic location of the segment is entirely within the Inner Bluegrass Region.

Water Quality Data

Water quality of the Kentucky River is unfavorably influenced as a result of wasteloads related to the City of Frankfort. Wastewater collection and treatment facilities are inadequate both in quality and quantity. Combined sewers serve the older portions of the city and contain numerous overflows and by-passes. During periods of light to heavy rainfall, by-passing occurs frequently dumping raw sewage into the river. The quantity of by-passing is dependent upon several factors, including frequency and intensity of rainfall, time of day and ground water conditions. Trunk sewers serving the Glenn's Creek drainage area of the city and east Frankfort have inadequate capacity for conveying sanitary wastewater to the combined system during wet weather periods, indicating inflow/infiltration problems.

Point Source Dischargers

Significant point source dischargers include the City of Frankfort, (Discharger #23) and Schenley Distillery (Discharger #24). The municipal discharge occurs at River Mile 64.5 on the Kentucky River and the Distillery discharge is located 0.5 stream miles above the confluence of the Kentucky River on Penitentiary Run. One minor discharge, Bald Knob School is located on Stoney Creek. The location of significant dischargers are shown on EXHIBIT B-2m and the characteristics of all dischargers in the segment are listed on EXHIBIT B-12.2t.

Non-point Source Dischargers

Urban run-off is a significant non-point source in Segment #12. Numerous by-pass points in the combined portion of the wastewater collection system contribute considerably to degradation of water quality during periods of overflow and by-passing. In addition, construction of new subdivisions, shopping centers, roads and similar facilities contribute sediment to the streams of the segment although not in significant amounts.

Waste Water Allocation and Priority

Based on a suggested treatment level of T1A the City of Frankfort has been assigned a maximum T.O.D. of 5,630 pounds per day. EXHIBIT B-12.3t lists the associated initial wastewater parameters. As a

Exhibit 12.2t — Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l Flow (mgd)	BOD	SS	NH3-N	Other
023	Frankfort STP	Kentucky River (435.6-65.4)	Ky. 0022861	Prim.	318.7	3.0	130.0	90.0	18.0	DO = 1.0
024	Schenley Distillery	Penitentiary Run-Ky. River (65.2-0.25)	Ky. 0001236	E.A.	0	0.24	20.0	30.0	1.0	DO = 5.0
339	Bald Knob School	UT-Stoney Cr. Kentucky River		E.A.	0.0	0.005	35.0	40.0	3.0	

Exhibit B-12.3t

Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)					Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04023	Frankfort STP	5630	5.0	30/1251	30/1251	20/834	4.0		5779 Ba
04024	Schenley Distillery	270.2	0.24	30/ 60.0	30/ 60.0	20/ 40.0	4.0		

result of all the contributing factors to water quality, Segment #12 was assigned a high priority which was computed using the following factors:

Population	21
Severity of Pollution	4479
Non-point Sources	100
Segment Priority	4600

EXHIBIT B-12.4t lists the computation of the construction abatement priority for the City of Frankfort.

Exhibit B-12.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Frankfort)				
Treatment	.206	2.0	4500	1850.8
I/I	.032	1.5	4500	217.7
Collectors	.452	1.0	4500	2032.3
Interceptors	.145	2.0	4500	1306.5
Combined Sew.	.165	0.5	4500	372.0
Total Abatement Priority				5779

Municipal Needs

Wastewater treatment facilities for the City of Frankfort need upgrading to the treatment level of TlA (secondary), in order to meet the water quality requirements. The present wastewater system is in poor condition and needs upgrading both in quality and quantity. EXHIBIT B-12.5t lists the city's needs and related costs with respect of wastewater facilities.

Exhibit B-12.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04023	Frankfort STP	TlA / TlA	6,600 lbs./day	T - 5.1 I/I- 0.8 C -11.2 I - 3.6 CS - 4.1	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

The wastewater treatment facilities existing for the City of Frankfort with improvement and enlargement should serve as a regional facility for collection and treatment of domestic and certain industrial wastes.

A 201 Facilities Plan is presently being conducted for the city that will provide time schedules, costs and recommendations relative to inclusion of other significant major and minor discharges into the regional system. Cost effective solutions are being sought.

Alternatives are related to internal planning for collection and treatment facilities rather than regional alternatives. The 201 Facility Plan should address questions relating to the use of one or more treatment plants evaluated on a cost effective basis. Management of storm water run-off that results in bypassing of the combined system is another significant problem. Inflow/infiltration problems are reported in certain portions of the separate sanitary system should the inflow/infiltration be determined to be in excess of that acceptable to the regulatory agencies, this problem will also need to be addressed on a cost effective basis. Physical management of the proposed regional system will need to be evaluated.

SEGMENT #13 ANALYSIS
435.6-65.0/82.5

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 185

Location

The location of Segment #13 is that reach of the main stem of the Kentucky River between Lock and Dam #4, (RM 65.0) and Lock and Dam #5 (RM 82.5).

Basic Planning Data

Segment #13 is comprised of 174 square miles which includes approximately 80% of the City of Frankfort, the City of Versailles and portions of rural Shelby, Anderson, Woodford and Franklin Counties. In addition, there are several small rural settlements scattered throughout the segment. The population of the segment was estimated to be 34,435 in 1975 and is projected to increase to 51,689 by 1995.

Frankfort's Central Business District is located within this segment as are some of the city's most rapidly expanding residential areas and the Capitol City Airport. A great deal of commercial development is currently taking place along 127 between U.S. 60 and the I-64 interchange. Principal employer in the Frankfort portion of the segment is the Schenley Distillers, Incorporated, with 350 employees engaged in the manufacture of whiskey. This portion of the City of Frankfort had an estimated 1975 population of 19,211 and is projected to increase to 32,166 by 1995.

Versailles, located in Woodford County, had an estimated population of 6,729 in 1975 and is projected to increase to 11,817 by 1995. Principal employers in the segment include GTE Sylvania, Inc., which employs 225 in the manufacture of fluorescent lamps, the International Paper Company with 64 employees engaged in the production of milk containers, the Kuhlman Electric Company with 450 employees producing transformers, the Rand McNally Company, with 800 employees engaged in job printing, map printing and bookbinding, and, Texas Instruments, Inc., with 680 employees engaged in the manufacture of thermostats and electric motor protectors.

Approximately 127.9 square miles of the rural portion of the segment was devoted to agriculture in 1975, and 39.9 square miles were in forest and woodland. The urban area of the segment comprised 6.2 square miles in 1975 and is projected to increase to 10.3 square miles by 1995.

Exhibit B-13.1t Basic Planning Data

Segment #13	Projection Years			
	1970	1975	1980	1995
Population Total	30,956	34,435	38,372	51,689
Rural	8,193	8,495	8,323	7,706
Farm	8,193	8,495	8,323	7,706
Non-Farm	-	-	-	-
Urban	22,763	25,940	30,049	43,983
Housing Unit Total	9,781	11,131	12,736	18,474
Rural	2,589	2,748	2,761	2,731
Urban	7,192	8,383	9,975	15,743
Land Use (Sq. Mi.)	174.0	174.0	174.0	174.0
Rural	168.5	167.8	166.9	163.7
Agriculture	128.6	127.9	127.0	123.8
Silviculture	39.9	39.9	39.9	39.9
Mining	-	-	-	-
Construction	-	0.7	0.9	3.2
Urban	5.5	6.2	7.1	10.3

Classification

The segment is classified as Effluent Limited because there are no water quality violations that affect the Kentucky River. Numerous small "package" treatment plants are located on tributary streams within the segment and may have impact on water quality of the tributary stream, with no effect on the main stem of the Kentucky River comprising Segment #13.

Segment Hydrology

The main stem of the Kentucky River within the segment has a thalweg slope of 0.8 feet per mile and a hydraulic slope of 0.0 feet per mile, and the pool elevation is 468.58 feet MSL. Major tributaries within the segment are Benson Creek, and Glenn's Creek. The segment area contains 191.5 square miles; 7-day, 10-year low flow for the segment is 280 cfs. The segment is located in the Inner Bluegrass Physiographic Region except for a small portion of Benson Creek which lies in the Hills of the Bluegrass. The drainage area of the Kentucky River above Segment #13 is 4,888.4 square miles. All tributary streams have zero flow on a 7-day, 10-year low flow basis.

Water Quality Data

Water quality of the main stem is excellent, however, there are two major tributaries that have water quality problems. One, Glenn's Creek, contains two significant discharges and two minor discharges that result in degradation of the creek. A similar condition exists on Benson Creek due to the pressure of ten minor discharges. The contributing flow of Glen's Creek and Benson Creek to the main stem of the Kentucky River does not have a significant effect on water quality of the main stem.

Point Source Dischargers

The wastewater treatment plant for the City of Versailles discharges into Glenn's Creek, (Rm 12.5) and National Distillers which discharges into Glenn's Creek (RM 0.5). Both of these dischargers are significant. EXHIBIT 13.2t lists standards violations for the Versailles wastewater discharge. EXHIBIT 13.3t lists existing discharge characteristics for all dischargers in the segment, and the location of the significant dischargers are shown in EXHIBIT B-2m.

Exhibit B-13.2t Standard Violation

Versailles STP, (04025); Glenn's Creek						
	Parameter (mg/l) = Standard/Violation					
Date	BOD	NH3-N	TSS	DO	P	Other
6/10/74		2.0 8.5	15.0 24.0	5.0 3.2		
6/24/74	10.0 17.0	2.0 18.3	15.0 32.0	5.0 0.9		
7/ 8/74	10.0 23.0	2.0 9.3	15.0 53.0			
7/22/74	10.0 12.0	2.0 16.0	15.0 29.0			
8/ 5/74	10.0 29.0	2.0 14.4	15.0 33.0			
8/19/74	10.0 74.0	2.0 12.5	15.0 184.0			

Exhibit B-13.3t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
025	Versailles STP	Glenn's Creek 71.4-12.5	Ky. 0020621	TF & LS	0.0	0.375	3.0	5.0	1.0	DO = 7.2
026	National Distillers	Glenn's Creek 71.4-0.5	Ky. 0001252 Ky. 0001244	E.A.	0	0.4	30.6	28.0	12.0	DO = 5.0
117	Stewart Home School & New Dormitory	UT-Benson		E.A.	0	0.005 0.005	35.0	35.0	4.0	
110	Whippoorwill Spring Golf Course	Sink Hole		E.A.	0	NA	80.0	60.0	18.0	
111	Standard Oil Compant	UT-Benson Creek		E.A.	0	0.001	20.0	40.0	3.0	
112	Shelby County High School	Benson Creek		E.A.	0	0.0075	35.0	38.0	4.0	
115	Evergreen Mobile Home Court	S.Benson Cr.		E.A.	0	0.001	35.0	35.0	4.0	
113	Stephens Mobile Home Court	S.Benson Cr.		E.A.	0	0.0015	40.0	40.0	8.0	
114	Jones Lane Mobile Home Park	S.Benson Cr.		E.A.	0	0.0075	40.0	40.0	8.0	
116	Shady Acres Mobile Home Park	S.Benson Cr.		E.A.	0	0.0075	40.0	40.0	8.0	
118	J & B Distributors	UT-Benson Cr.		E.A.	0	0.0005	20.0	25.0	3.0	
119	Willowcrest Subdivision	S.Benson Cr.		E.A.	0	0.04	38.0	40.0	8.0	
120	Bridgeport School	S.Benson Cr.		E.A.	0	0.0071	35.0	35.0	5.	
121	Alton Mobile Home Park	S.Benson Cr.		E.A.	0	0.009	40.0	40.0	8.0	
122	Harrod-Carter	S.Benson Cr.		E.A.	0	0.001	25.0	30.0	4.0	

Exhibit B-13.3t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
123	Sylvania	Glenn's Creek		C.W.	0	0.002	-	10.0	-	
124	Milleville Elem. School	Glenn's Creek		E.A.	0	0.003	35.0	35.0	4.0	

Exhibit B-13.4t Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04025	Versailles STP	67	0.4	10/ 33	15/ 50	1/ 3.3	8.0	6-9 pH	240 Ca
04026	National Distillers	563	0.5	30/125	30/125	20/84	4.0	6-9 pH	

Non-point Source Dischargers

There is urban run-off from portions of the City of Frankfort into Segment #13. Other non-point sources are insignificant.

Waste Load Allocation and Priority

Based on water quality modeling, the City of Versailles has been assigned a maximum daily T.O.D. of 563 pounds per day. EXHIBIT B-13.4t lists all waste load parameters of the significant dischargers. (See alternative water quality management plan of this segment).

Due to water quality violations in Glenn's Creek and urban run-off from a portion of the City of Frankfort this segment has been assigned a medium priority of 185 using the following factors:

Population	18.0
Severity of Pollution	142.0
Non-point Sources	25.0
Segment Priority	185.0

The construction abatement priority for the City of Versailles is tabulated in EXHIBIT B-13.5t.

Exhibit B-13.5t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Versailles)				
Treatment	.088	4.5	160	63.4
I/I	.035	1.5	160	8.4
Collectors	.702	1.0	160	112.3
Interceptors	.175	2.0	160	56.1
Combined Sew.	-	-	-	-
Total Abatement Priority				240

Municipal Needs

As indicated on EXHIBIT B-13.2t existing treatment provided by the wastewater treatment facility for Versailles is inadequate to satisfy water quality standards in Glenn's Creek. Upgrading the treatment facility to a level of T4B will be necessary to maintain water quality in the receiving stream. EXHIBIT B-13.6t lists municipal needs for this treatment facility and associated costs.

Exhibit B-13.6t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04025	Versailles STP	T4B / T4B	1,775 lbs./day	T - 0.6 I/I- 0.2 C - 4.0 I - 1.0	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

Wastewater treatment facilities for the City of Versailles need upgrading to a T4B to the effluent discharge characteristics shown in EXHIBIT B-13.4t. Violations listed include B.O.D., NH3-N, D.O. and SS. Alternative plans for upgrading the treatment facility should be analyzed on a cost effective basis with due consideration given to land disposal of effluent, extended aeration sand filtration following the existing lagoon, break-point chlorination, ion exchange and reaeration or various combinations of the above processes.

National Distillers have the option of leaving the present discharge in place and providing T4B treatment or constructing 0.5 miles of effluent pipe to the main stem of the Kentucky River. A third alternative is discharging the effect into the wastewater collection system of the City of Frankfort.

SEGMENT #14 ANALYSIS
435.6-82.5/96.2

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 18.0

Location

Segment #14 is located on the main stem of the Kentucky River from Lock and Dam #5 (RM 82.5) to Lock and Dam #6 (RM 96.2) and contains portions of Jessamine, Anderson, Woodford, and Mercer Counties.

Basic Planning Data

Segment #14 contains 116.82 square miles of area comprised of rural portions of Mercer, Woodford, Jessamine and Anderson Counties. Population in the segment was estimated to be 4,590 in 1970 and is projected to increase slightly, to 4,760 by 1995.

The major share of segment #14 is devoted to agriculture with some 18.5 square miles in forest and woodland.

Exhibit B-14.1t Basic Planning Data

Segment #14	Projection Years			
	1970	1975	1980	1995
Population Total	4,590	4,639	4,654	4,760
Rural	4,590	4,639	4,654	4,760
Farm	4,590	4,639	4,654	4,760
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	1,396	1,440	1,480	1,604
Rural	1,396	1,440	1,480	1,604
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	98.3	98.3	98.3	98.3
Silviculture	18.5	18.5	18.5	18.5
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Segment #14 is classified as Effluent Limited due to the high 7-day, 10-year low flow which gives an assimilative capacity much higher than the present or proposed waste loads anticipated.

Segment Hydrology

The main stem of the Kentucky River through Segment #14 has a 7-day, 10-year low flow of 280.3 cfs. There are three major tributaries which are contained within the segment: (1) Grier Creek, (2) Gilbert Creek, and (3) Clear Creek. All of the tributaries frequently have zero flow during dry weather periods. The thalweg slope, between Lock and Dam #5 and Lock and Dam #6 is 1.1 feet per mile, and the hydraulic slope is 0.0 feet per mile due to impoundments. This results in a pool elevation of 483.5 feet (MSL). Segment #14 is contained in the Inner Bluegrass Physiographic Region. The area contained within the segment is 160 square miles and the drainage area above the segment is 4,728.4 square miles.

Water Quality Data

Water quality modeling indicated a high dissolved oxygen content (in excess of 8.0 ppm.) Based on this information water quality appears to be excellent.

Point Source Dischargers

There are four significant point source dischargers in the segment. They are: Austin Nichols Distillery (#028), Kentucky Utilities (#027), Universal Button (#029), and Kentucky Stone (#030). In addition four minor point source dischargers are located in the segment. They are: Central Kentucky Parkway Toll Station (#340), Fox Creek RECC (#341), Harold Peach Complex (#342), and YMCA Camp Otonka (#343). EXHIBIT B-14.2t lists type of treatment, flow and discharge characteristics for each discharger. The significant dischargers are graphically located on EXHIBIT B-2m.

Non-point Source Dischargers

Dischargers from non-point sources are insignificant within the segment. Land use within the segment is devoted primarily to agricultural purposes.

Waste Load Allocations and Priority

Waste load allocations and segment priority are set forth in EXHIBIT B-14.3t. The segment priority was derived using the following factors:

Population	4.9
Severity of Pollution	13.1
Non-point Sources	0.0
Segment Priority	18.0

Municipal Needs

There are no significant dischargers in the segment, however it should be pointed out that the City of Lawrenceburg, which presently discharges municipal wastewater to a tributary of the Salt River Basin may consider pumping treated effluent to the Kentucky River Basin which would enter the main stem within Segment #14. Reference should be made to the Salt River Report.

Alternative Water Quality Management Plan

Alternative water quality management planning should consider the discharging of the municipal discharge to the Kentucky River Basin in lieu of the Salt River Basin, as this alternative should prove more cost effective than providing the additional treatment needed to continue discharging in the present location. In the event the discharge is diverted to the Kentucky River Basin, combining of the treatment facilities at Austin Nichols Distillery and Lawrenceburg should be considered. Land application of the effluent from the present municipal treatment plant is also an alternative that should be considered on a cost effective basis. This alternative would negate the higher treatment requirements for discharging into the Salt River Basin with its attendant 7-day, 10-year low flow conditions.

Exhibit B-14.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
028	Austin-Nichols Distillery	Kentucky River (435.6-83.75)	Ky. 0001643	A.L.	310.7	0.52	30.0	28.0	1.0	DO = 5.0
027	Kentucky Util.	Ky. River at Tyrone (435.6-84.6)		C.W.	309.9	187.7	NA	NA	NA	
029	Universal Button	Cedar Brook-Ky. River (435.6-84.9-4.0)		Chemical/ Physical	0.0	0.15	-	20.0	-	
030	Kentucky Stone Company	Kentucky Stone Company	Ky. 0002551	Surface Drained	309.9	0.05	-	39.0	-	
340	Central Ky. Toll Plaza	Ditch to Gilbert Creek		ST & SF	0	0.002	15.0	5.0	4.0	
341	Fox Creek RECC	UT-Cedar Brook Run		E.A.	0	0.002	-	-	-	
342	Harold Peach Complex	Hammonds Creek		E.A.	0	0.003	45.0	40.0	5.0	
343	YMCA Camp Otonka	Kentucky River		E.A.	310	0.001	35.0	30.0	3.0	

Exhibit B-14.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04028	Austin-Nichols Dist.	619.2	0.55	30/138	30/138	20/92	4.0	6-9 pH	
04027	Kentucky Utilities Tyrone (C/W)	NA	187.7	-	-	-	-	-	
04029	Universal Button	19	0.15	-	15/ 19	-	-	6-9 pH	
04030	Kentucky Stone	12.5	0.05	-	30/125	-	-	6-9 pH	

SEGMENT #15 ANALYSIS
435.6-5.19-0.0/m.8

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 28.7

Location

Segment #15 is located entirely in Franklin County in the Inner Bluegrass and Hills of the Bluegrass Physiographic Regions. The segment begins at the confluence of Elkhorn Creek and the Kentucky River and extends to the confluence of North and South Forks of Elkhorn Creek (RM 17.8).

Basic Planning Data

Segment #15 contains approximately five percent of the population of the City of Frankfort and 37.5 square miles of rural and urban fringe Franklin County. The population of the City of Frankfort which lies within this segment was estimated to be 1,068 in 1970 and projected to increase to 2,010 by 1995.

Principal employers in this segment include the Central Screw Company with 210 employees engaged in the manufacturer of screws, nuts and bolts, and the Old Grand Dad Distillery, producer of whiskey.

The rural sector of Segment #15 contains an estimated 24 square miles devoted to agriculture and 13.5 square miles of forest and woodland.

Exhibit B-15.1t — Basic Planning Data

Segment #15	Projection Years			
	1970	1975	1980	1995
Population Total	3,425	3,519	3,543	3,566
Rural				
Farm	2,357	2,319	2,163	1,556
Non-Farm	-	-	-	-
Urban	1,068	1,200	1,380	2,010
Housing Unit Total	1,097	1,166	1,270	1,366
Rural	755	777	829	1,024
Urban	342	389	441	342
Land Use (Sq. Mi.)				
Rural				
Agriculture	24.0	24.0	23.9	23.7
Silviculture	13.5	13.5	13.5	13.5
Mining	-	-	-	-
Construction	-	-	0.1	0.2
Urban	0.4	0.4	0.5	0.7

Classification

Elkhorn Creek is augmented by flow from upstream dischargers. These effluents have been totally reaerated by natural processes prior to entering Segment #15, and result in a 7-day, 10-year low flow of 28.25 cfs including the natural flow. This segment is therefore classified as Effluent Limited.

Segment Hydrology

This segment is located in the Inner Bluegrass and Hills of the Bluegrass Physiographic Regions and has a total drainage of 37.9 square miles with an upstream drainage area of 458.1 square miles. The average stream slope in the segment is 11.8 feet per mile. A portion of the City of Frankfort is located in the upper end of this segment. Urban run-off has a small effect on water quality in the segment. The land use is predominately agricultural with some forested areas.

Water Quality Data

Water quality data is non-existant on Elkhorn Creek in this segment. Based on water quality modeling of the stream it is concluded that water quality is good. Additional data should be obtained.

Point Source Dischargers

There are two significant point source dischargers within this segment. They are Old Grand Dad Distillery, (#009), and Central Screw, (#008) which discharges cooling water only. EXHIBIT B-15.2t lists all dischargers and their respective wastewater criteria. The significant dischargers in Segment #15 are graphically located on EXHIBIT B-2m.

Non-point Source Dischargers

Non-point source dischargers would include some urban run-off from the northeastern portion of the City of Frankfort.

Waste Load Allocation and Priority

The waste load allocation for Segment #15 is 227.6 pounds per day of T.O.D. A detailed breakdown of this allocation is shown on EXHIBIT B-15.3t. The segment priority of 28.7 was computed using the following factors:

Population	3.7
Severity of Pollution	0.0
Non-point Sources	25.0
Segment Priority	28.7

Municipal Needs

The City of Frankfort is presently conducting a 201 Facilities Plan for determining facilities needed including treatment facilities, trunk line and collector sewers. Further detail is given in Segment #12 analysis. There are no other municipalities in this segment.

Alternative Water Quality Management Plan

As previously discussed the 201 Facility Plan should include evaluation of the incorporation of smaller dischargers that exist on the outskirts of the city. In addition, industrial waste presently being discharged independently of the municipal system should be evaluated for inclusion in the municipal system on a cost effective basis. Additional information regarding the water quality management plan will result as the 201 Facility Plan is developed.

Exhibit B-15.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
169	Elkhorn Mobile Home Sale	Elkhorn Creek		E.A.	2.0	0.0021	40.0	40.0	4.0	
009	Old Grand Dad	Elkhorn Creek		TF, CS & S	2.0	0.2	30.4	35.0	14.0	
008	Central Screw	Elkhorn Creek		C.W.	2.0	0.11	-	-	-	

Exhibit B-15.3t

Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04009	Old Grand Dad	225.2	0.2	30/50.0	30/50.0	20/33.4	4.0	6-9 pH	
04008	Central Screw	C/W	0.11	-	-	-	-	-	

SEGMENT #16 ANALYSIS
435.6-51.9-17.8-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 1200

Location

Segment #16 begins at the confluence of North Elkhorn Creek with Elkhorn Creek (RM 17.8) and includes all of North Elkhorn Creek and its associated tributaries. The segment contains portions of Franklin, Scott and Fayette Counties.

Basic Planning Data

Segment #16 contains portions of Franklin, Scott and Fayette Counties, the City of Georgetown, a portion of northeast Lexington, and the rural non-farm community of Stamping Ground. The population in the segment was estimated to be 26,701 in 1975, and is projected to increase to 36,046 by 1995.

The portion of Lexington in Segment #16 contains Lexington Country Club and suburban residential subdivisions. The population of this part of Lexington was estimated to be 9,169 in 1975 and is projected to increase to 13,851 by 1995.

Georgetown is in the Scott County portion of the segment and had an estimated 1975 population of 9,264. The population of Georgetown is projected to increase to 11,978 by 1995. Principal employers in Georgetown include:

- Blue Ribbon Pen and Pencil Co., Inc. - 120 employees (imprinted pens, pencils)
- Clark Equipment Company - 525 employees (electric fork lifts)
- Electric Parts Corporation - 470 employees (power cords, electric wire, wiring harnesses)
- Johnson Service Co. - 299 employees (environmental control systems)
- Mallard Pen and Pencil Co., Inc. - 145 employees (ballpoint pens)
- Teledyne Kentucky Die Casting - 98 employees (aluminum die castings)
- Universal Wire Spring Division, Hoover Ball & Bearing Co., - 478 employees (bed springs, auto seat springs, frame furniture springs, metal frames for box springs).

Water Quality Data

Considerable water quality data was collected by Dr. Edward G. Foree and documented.(1) Results of sampling indicate that water quality is satisfactory except for total coliform and fecal coliform criteria. These parameters were in violation at least 50% of the time.

(1) Assessment of Surface Water Quality in the Lexington, Kentucky Metropolitan Area.

Exhibit B-16.1t — Basic Planning Data

Segment #16	Projection Years 1970	1975	1980	1995
Population Total	25,940	26,701	28,768	36,046
Rural	9,226	8,268	8,687	11,968
Farm	8,815	7,832	8,227	11,438
Non-Farm	411	436	460	530
Urban	16,714	18,433	20,081	24,078
Housing Unit Total	7,986	8,441	9,286	12,363
Rural	2,846	2,660	2,830	3,978
Urban	5,140	5,781	6,456	8,385
Land Use (Sq. Mi.)				
Rural				
Agriculture	198.6	198.3	197.9	196.8
Silviculture	27.7	27.7	27.7	27.7
Mining	-	-	-	-
Construction	-	0.3	0.4	1.1
Urban	4.1	4.4	4.8	5.9

Classification

Due to the lack of stream flow during dry weather periods, the segment has been classified as Water Quality Limited.

Exhibit B-16.2t — Standard Violation

Lexington-Bluegrass Army Depot, (04014); Avon

Date	Parameter (mg/1) = Standard/Violation BOD	NH3-N	TSS	DO	P	Other
7/22/74	10.0 / 13.0		15.0 / 31.0	5.0 / 2.8		
8/ 5/74		2.0 / 2.8				
8/19/74	10.0 / 12.0		15.0 / 42.0	5.0 / 4.2		

Georgetown STP, (04010); North Elkhorn Creek

Date	Parameter (mg/1) = Standard/Violation BOD	NH3-N	TSS	DO	P	Other
6/10/74	10.0 / 52.0	2.0 / 8.0	15.0 / 102.0			
6/24/74	10.0 / 31.0	2.0 / 7.8	15.0 / 84.0			
7/ 8/74	10.0 / 48.0	2.0 / 19.9	15.0 / 57.0	5.0 / 4.7		
7/22/74	10.0 / 28.0	2.0 / 12.5	15.0 / 18.0			
8/ 5/74	10.0 / 39.0	2.0 / 10.3	15.0 / 54.0			
8/19/74	10.0 / 22.0	2.0 / 8.4	15.0 / 21.0			

Segment Hydrology

The segment is located in the Inner Bluegrass and Hills of Bluegrass Physiographic Regions with a drainage area of 223.2 square miles. The stream slope averages 4.6 feet per miles. Major tributaries include Lecompter Creek, and McConnell's Run. Except for areas in and near the cities of Georgetown and Lexington, land use is primarily agricultural in nature.

Point Source Dischargers

Two significant point source dischargers are located in the segment, including the City of Georgetown (#10) and the U.S. Army Depot near Avon (#14). These dischargers are graphically located on EXHIBIT B-2m. Standards violations are listed in EXHIBIT B-16.2t. It should be noted that the City of Georgetown is presently in the process of upgrading and expanding wastewater treatment facilities to the secondary level. All point source discharges and their related characteristics are shown on EXHIBIT B-16.3t.

Non-point Source Dischargers

Urban run-off from portions of the Cities of Lexington and Georgetown contribute to degradation of water quality in the segment. The seriousness of this problem is not documented by available data. Such data should be obtained at a future date. Another non-point source within the segment is associated with the lack of adequate wastewater collection and disposal facilities for the City of Stamping Ground.

Waste Load Allocation and Priority

The total waste load allocation is 219.3 pounds of T.O.D. per day. A breakdown of this allocation is presented on EXHIBIT B-16.4t. Using the following factors, the segment priority was calculated to be:

Population	27.1
Severity of Pollution	1,063.9
Non-point Sources	100.0
Segment Priority	1,200.0

The construction abatement priority for the Cities of Georgetown and Stamping Ground are calculated on EXHIBIT B-16.5t.

Municipal Needs

The City of Georgetown is presently upgrading the wastewater treatment facilities to produce a secondary effluent. Additional treatment must be provided to achieve a T4B treatment level. In addition, inflow/infiltration is a very serious problem and should be removed on a cost effective basis. Where economically possible, trunk lines need extending outside the corporate limits to include other point source dischargers that will not meet proposed effluent standards. Due consideration to the above mentioned problems and alternatives should be evaluated during the 201 Facilities Planning process.

Exhibit B-16.3t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/1				
						Flow (mgd)	BOD	SS	NH3-N	Other
014	U.S. Army Depot	North Elkhorn Creek		C.P.	0.0	0.065	19.0	27.0	4.5	
010	Georgetown STP	North Elkhorn Creek		T.F.	0	1.25	57.0	60.0	16.0	
170	Longview Farm	UT-North Elkhorn Creek		E.A.	0.0	0.002	40.0	40.0	8.0	
171	Scott County Dog Pound	UT-North Elkhorn Creek		E.A.	0.0	0.0021	35.0	30.0	4.0	
172	Nally & Gibson	UT-North Elkhorn Creek		Surface Drainage	0.0	0.010	25.0	35.0	12.0	
335	Capital Estates Mobile Home Pk.	North Elkhorn Creek		E.A.	1.34	0.012	35.0	40.0	8.0	
337	Belt-Line Circ. Theatre #25	UT-North Elkhorn Creek		ST & SF	0.0	0.005	15.0	5.0	4.0	
378	Scott County High School	UT-North Elkhorn Creek		E.A.	0.0	0.009	30.0	30.0	4.0	

Exhibit B-16.4t Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/1 / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/1)	Other	
04014	U.S. Army Depot	1.08	0.065	10/ 5.4	15/ 8.1	1.0/ 0.5	8.0	6-9 pH	
04010	Georgetown STP	208.5	1.25	10/104.3	15/156.4	1.0/10.4	8.0	6-9 pH	2112 Ca

Exhibit B-16.5t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Georgetown)				
Treatment	.225	4.5	1075	1090.1
I/I	.070	1.5	1075	113.6
Collectors	.563	1.0	1075	605.6
Interceptors	.141	2.0	1075	302.8
Combined Sew.	-	-	-	-
Total Abatement Priority				2112

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Sadieville)				
Treatment	.385	4.5	25	43.3
I/I	-	-	-	-
Collectors	.462	1.0	25	11.6
Interceptors	.154	2.0	25	7.7
Combined Sew.	-	-	-	-
Total Abatement Priority				63

The City of Stamping Ground presently lacks a comprehensive wastewater collection and treatment system. A 201 Facilities Plan has been completed and approved by the Federal Environmental Protection Agency. The proposed treatment scheme, (biological treatment followed by filtration) should meet proposed effluent standards.

Municipal needs for the City of Lexington is discussed in Segment Analysis #17 and #25.

EXHIBIT B-16.6t lists municipal needs and their related costs for Segment #16.

Exhibit B-16.6t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04010	Georgetown STP	T4B T4B	2,045 lbs./day	T - 0.8 I/I- 0.25 C - 2.0 I - 0.5	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternate Water Quality Management Plan

The present state water quality strategy does not include a monitoring facility at any point on North Elkhorn Creek. It is recommended that a secondary monitoring station be located in the segment due to the size of the drainage basin and location of significant urban areas in the segment.

Regionalization of wastewater facilities near Georgetown should be considered during the 201 Facilties Planning Process.

SEGMENT #17 ANALYSIS
435.6-11.0-17.8-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 4,950

Location

Segment #17 begins at the confluence of South Elkhorn Creek and Elkhorn Creek, (RM 17.8) and extends to the headwaters of South Elkhorn and its tributaries. Portions of the Counties of Fayette, Jessamine, Woodford, Franklin and Scott lie within this segment.

Basic Planning Data

Segment #17 includes approximately five percent of the City of Frankfort, the rural non-farm community of Midway, and parts of rural Fayette, Franklin, Jessamine, Scott and Woodford Counties. Segment #17 encompasses 182.5 square miles and contains the largest population of all the Kentucky River Basin segments. The 1975 population of the segment was estimated to be 110,400 and projected to increase to 164,495 by 1995.

The portion of Frankfort which lies within Segment #17 had an estimated population of 1,200 in 1975, projected to increase to 2,010 by 1995.

The Lexington area within segment #17 contains the University of Kentucky with over 15,000 students, Keeneland Race Course, the Blue Grass Airport and numerous thoroughbred horse farms. The estimated 1975 population of this sector of Lexington was 100,854 and is projected to increase to 152,360 by 1995.

The Woodford County rural non-farm community of Midway had an estimated population of 1,339 in 1975 projected to increase to 1,625 by 1995.

The principal employers in the segment are in the Lexington area, with 24 manufacturing firms employing 100 or more workers and many more with fewer than 100 employees. The largest employers in the segment are IBM with 5,583 employees engaged in the production of electric typewriters and supplies and photocopy machines, the Square D Company, manufacturer of electrical equipment with 1,732 employees and Parker Seal Company with 900 employees engaged in the production of synthetic rubber rings, seals and cord.

The major share of the segment is in agricultural use with an estimated 17.5 square miles in forest and woodland. In 1975, the urban area of this segment encompassed some 21.2 square miles with an additional 10.7 square miles of rural land projected to be given over to urban use by 1995.

Other principal manufacturing employers in the segment include:

- American Can Co. - Dixie Products, 405 employees (paper cups, containers, plates)
- American Technical Industries, Inc. - 450 employees (artificial Christmas Trees, wreaths brush hair curlers)
- The American Tobacco Co., - 121 employees (Tobacco stemming and redrying)
- Blue Grass Coca Cola Bottling Co., - 108 employees (soft drinks)
- Brown & Williamson Tobacco Corp., - 447 employees (redrying tobacco)
- General Electric Co, Kentucky Glass Plant - 100 employees (incandescant light bulbs)
- General Electric Co., Lexington Lamp Plant - 312 employees (sealed beam automotive headlamps)
- Irvin Industries, Inc. - 800 employees (auto seat belts, air structures, metal parts)
- Lexington Herald-Leader Co. - 380 employees (newspapers)
- Mid States Enterprises, Inc. - 225 employees (electrical, mechanical, sub-assembly, screw feeding equipment)
- Opportunity Workshop of Lexington - 110 employees (typewriter parts, electric wiring components, wood boxes and pallets)

- Perry Lumber Co., - 106 employees (millwork boxes, crates)

- Procter and Gamble Manufacturing Co., - 157 employees (peanut butter)

- Rainbo Baking Co - 196 employees (bread, rolls)

- R.J. Reynolds Tobacco Co. - 400 employees (tobacco processing)

- Standard Products Co., - 240 employees (motor vehicle weather strip)

- Trane Co., - 750 employees (air conditioning equipment, heating equipment, air handling equipment)

- G.F. Vaugan Tobacco Co., Inc. - 200 employees (tobacco stemming, redrying)

- Vogue Rattan Manufacturing Co., Inc. - 140 employees (rattan furniture)

- V.R. Wesson Division of Fansteel - 225 employees (carbide inserts, carbide tipped tools, mining tools)

- Westinghouse Air Brake Co., Fluid Power Division 300 employees (pneumatic valves, pneumatic and hydraulic cylinders)

Exhibit B-17.1t Basic Planning Data

Segment #17	Projection Years			
	1970	1975	1980	1995
Population Total	99,710	110,400	122,030	164,459
Rural	9,701	8,346	8,651	10,089
Farm	8,423	7,007	7,251	8,464
Non-Farm	1,278	1,339	1,400	1,625
Urban	90,009	102,054	113,379	154,370
Housing Unit Total	31,206	35,439	40,456	59,828
Rural	2,983	2,615	2,779	3,480
Urban	28,223	32,824	37,677	56,348
Land Use (Sq. Mi.)	182.5	182.5	182.5	182.5
Rural	163.8	161.3	159.0	150.6
Agriculture	146.3	143.8	141.5	133.1
Silviculture	17.5	17.5	17.5	17.5
Mining	-	-	-	-
Construction	-	2.5	2.3	8.4
Urban	18.7	21.2	23.5	31.9

Classification

Classification of the segment has been designated Water Quality Limited due to the total waste load entering the segment and the lack of sustained stream flows during low flow conditions. Water quality violations are listed in EXHIBIT B-17.2t.

Segment Hydrology

The total drainage area within the segment is 195.9 square miles and is included within the Inner Bluegrass Physiographic Region. Major tributary streams in the segment are; Shannon Run, Hickman Branch, Lee Branch, Town Branch, Steele's Branch and Cave Creek. A major portion of the City of Lexington is located in the headwaters of the segment and has an effect on segment hydrology. The average stream slope of South Elkhorn Creek within the segment is 6.4 feet per mile.

Point Source Dischargers

Significant point source dischargers within the segment are: Lexington, Midway, South Elkhorn Service Co., Monticello Estates, Federal Correctional Institution Keeneland Race Track, General Electric Co., Central Rock Co., and American Can Co. All dischargers and their wastewater characteristics are set forth on EXHIBIT B-17.3t. EXHIBIT B-3m graphically locates the significant dischargers.

Non-point Source Dischargers

Non-point source discharges occur as a result of run-off from the urban areas listed in the preceding paragraph. These sources, particularly non-point source discharge from the City of Lexington could be significant although specific data is not available.

Water Quality Data

Average values for water quality data collected by the University of Kentucky (1) on Town Branch, the receiving stream of the Lexington wastewater plant #1 are: D.O. 4.9 mg/l, B.O.D. 7.2 mg/l, pH 7.9, Total S.S. 10 mg/l, fecal coliform 600 per 100 ml, NH3-N 14.3 mg/l, Phosphorus 3.4 mg/l.

(1) Assessment of Surface Water Quality in the Lexington, Kentucky Metropolitan Region, by Dr. Edward G. Foree.

Lee Branch receives the effluent from the Midway wastewater treatment plant. Water quality data collected by the University of Kentucky on the main stem of the segment below the confluence of Lee Branch and South Elkhorn indicates the following average values: D.O. 6.5 mg/l, B.O.D. 2.4 mg/l, pH 7.7, Total S.S. 29 mg/l, fecal colifrom 4,100 per 100 ml, NH3-N 0.7 mg/l. Additional water quality data may be obtained from the above referenced source.

Water quality monitoring strategies proposed by the Division of Water, Department for Natural Resources, provide for a primary monitoring station on South Elkhorn Creek at approximately stream mile 19.7.

This station along with in-plant monitoring in Lexington and Midway should contribute substantially to the accumulation of additional water quality data.

Water quality violations are listed in EXHIBIT B-17.2t.

Exhibit B-17.2t

Standard Violation

Monticello Estates Subdivision,(04018); S.Elkhorn Cr.

Date	Parameter (mg/1) = Standard/Violation					
	BOD	NH3-N	TSS	DO	P	Other
6/10/74		2.0 18.0		5.0 1.2		
6/25/74	10.0 28.0	2.0 17.9	15.0 192.0	5.0 1.4		
7/ 8/74	10.0 25.0	2.0 20.7	15.0 37.0			
7/22/74	10.0 28.0	2.0 23.0	15.0 16.0	5.0 1.0		
8/ 5/74	10.0 23.0	2.0 18.6	15.0 58.0	5.0 1.8		
8/19/74	10.0 20.0	2.0 15.7	15.0 60.0	5.0 3.5		

South Elkhorn Service Co., (04017); S. Elkhorn Cr.

Date	Parameter (mg/1) = Standard/Violation					
	BOD	NH3-N	TSS	DO	P	Other
6/10/74	10.0 25.0	2.0 12.3	15.0 61.0			
6/24/74	10.0 30.0	2.0 10.7	15.0 67.0			
7/ 8/74	10.0 37.0	2.0 16.4	15.0 86.0	5.0 4.3		
7/22/74		2.0 8.8		5.0 4.9		
8/ 5/74	10.0 32.0	2.0 11.4	15.0 48.0	5.0 4.8		
8/19/74	10.0 65.0	2.0 16.6	15.0 242.0	5.0 3.7		

Lexington Town Br. STP, (04016); S. Elkhorn Creek

Date	Parameter (mg/1) = Standard/Violation					
	BOD	NH3-N	TSS	DO	P	Other
6/10/74	10.0 11.0	2.0 7.7	15.0 40.0			
6/24/74		2.0 7.9	15.0 24.0			
7/ 8/74		2.0 9.7	15.0 24.0			
7/22/74		2.0 10.0	15.0 18.0			
8/ 5/74		2.0 9.7	15.0 24.0			
8/19/74		2.0 13.7	15.0 32.0			

Federal Corr. Institution, (04063); S. Elkhorn Cr.

Date	Parameter (mg/1) = Standard/Violation					
	BOD	NH3-N	TSS	DO	P	Other
6/10/74		2.0 2.3				
6/24/74		2.0 3.3				
7/18/74		2.0 3.1				
7/22/74		2.0 4.2				

Midway STP, (04015); South Elkhorn Creek

Date	Parameter (mg/1) = Standard/Violation					
	BOD	NH3-N	TSS	DO	P	Other
6/10/74	10.0 80.0	2.0 11.3	15.0 75.0			
6/24/74		2.0 7.2	15.0 25.0			
7/ 8/74	10.0 10.0	2.0 14.3	15.0 43.0	5.0 4.2		
7/22/74	10.0 53.0	2.0 12.9	15.0 52.0			
8/ 5/74	10.0 35.0	2.0 12.0	15.0 30.0			

Waste Load Allocation and Priority

The maximum daily T.O.D. load to the segment from significant discharge source is 3,150 pounds per day. A breakdown of this total allocation is contained in EXHIBIT B-17.4t. The segment priority has been calculated using the following factors:

Population	120.3
Severity of Pollution	4,729.0
Non-point Sources	100
Segment Priority	4,950.0

The construction abatement priorities for the Cities of Lexington STP #1, and Midway are calculated on EXHIBIT B-17.5t.

Municipal Needs

Municipal needs for the Cities of Lexington and Midway are set forth on EXHIBIT B-17.6t. According to water quality modeling, both municipalities within the segment must provide a T4B treatment level.

The Midway wastewater treatment plant is antiquated. Its capacity is reported to be 122,000 G.P.D., however, during wet weather periods the flow often exceeds 300,000 G.P.D.

Exhibit B-17.3t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
015	Midway STP	Lee's Branch		T.F.	0	0.122	43.0	45.0	18.0	
016	Lexington STP	Town Branch		A.S.	0	18.0	20.0	24.0	18.0	
017	South Elkhorn Service Co.	South Elkhorn Creek		E.A.	0	0.230	33.0	78.0	13.5	
018	Monticello Estates Subd. STP	South Elkhorn Creek		E.A.	0	0.100	31.0	54.0	17.7	
019	Keeneland Race Track	Manchester Br.		EA & L	0	0.08	30.0	18.0	18.0	
020	General Electric	Shannon Creek		C.W.	0	0.10	-	-	-	
021	Central Rock Company	Town Branch		Pit Water	0	0.06	-	40.0	-	
022	American Can Company	Town Branch		C.W.	0	0.12	-	-	-	
063	Federal Corr. Institute	Steeles Run		E.A.	0	0.5	20.0	20.0	10.0	
173	Atha's Trailer Park	Slickway Br.		E.A.	0	0.004	30.0	30.0	4.0	
174	American Ser. Station-Jett	UT-Slickway Branch		S.T.	0	0.0075	45.0	50.0	18.0	
175	Gulf Service Station	Slickway Branch		S.T.	0	0.0009	20.0	25.0	4.0	
176	Mitchell Trailer Park	Slickway Branch		E.A.	0	0.005	40.0	40.0	8.0	
177	Jett Mobile Home Park	UT-Slickway Branch		E.A.	0	0.0015	40.0	40.0	8.0	
178	Sunoco Ser. Station	UT-Slickway Branch		E.A.	0	0.0015	20.0	35.0	4.0	
180	R.J. Reynolds Company	South Elkhorn Creek		T.F.	0	0.0225	30.0	30.0	4.0	
181	Airport Motel	Shannon Creek		EA & L	0	0.0084	25.0	35.0	4.0	

Exhibit B-17.3t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
182	General Electric	Wolfe Run		E.A.	0	0.003	30.0	30.0	4.0	
338	Green Meadows MHP	UT-South Elkhorn Creek		EA & L	0	0.0025	15.0	5.0	5.0	

Exhibit B-17.4t

Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04015	Midway STP	20.3	0.122	10/ 10.2	15/ 15.3	1.0/ 1.0	8.0	6-9 pH	196 Ca
04016	Lexington STP	3002.4	18.0	10/1501.2	15/2251.8	1.0/150.1	8.0	6-9 pH	7781 Aa
04017	South Elkhorn Service Company	38.4	0.23	10/ 19.2	15/ 28.8	1.0/ 1.9	8.0	6-9 pH	
04018	Monticello Estates Subdivision	26.7	0.16	10/ 13.3	15/ 20.0	1.0/ 1.3	8.0	6-9 pH	
04019	Keeneland Race Course	13.3	0.08	10/ 6.7	15/ 10.0	1.0/ 0.7	8.0	6-9 pH	
04020	General Electric	C/W	0.10	NA	NA	NA	NA		
04021	Central Rock Co.	Pit Water	0.06	NA	15/ 7.5	NA	NA	6-9 pH	
04022	American Can Co.	C/W	0.12	NA	NA	NA	NA		
04063	Fed. Correction Institution	49.0	0.06	20/ 10	30/ 15	15/ 7.5	8.0		

Exhibit B-17.5t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Lexington STP #2)				
Treatment	.113	4.5	4787	2424.3
I/I	.051	1.5	4787	369.4
Collectors	.643	1.0	4787	3078.5
Interceptors	.193	2.0	4787	1847.1
Combined Sew.	-	-	-	-
Total Abatement Priority				7781

Exhibit B-17.5t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Midway)				
Treatment	.55	4.5	64.4	159.4
I/I	.05	1.5	64.4	4.8
Collectors	.30	1.0	64.4	19.3
Interceptors	.10	2.0	64.4	12.9
Combined Sew.	-	-	-	-
Total Abatement Priority				196

The wastewater treatment plant serving the portion of Lexington that discharges into the segment has been recently upgraded, however, additional treatment must be provided to meet water quality standards. The plant utilizes the Krauss process and has a capacity of 18 M.G.D. The need for T4B treatment has been indicated as a result of water quality monitoring.

Exhibit B-17.6t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04015	Midway STP	T4B T4B	660 lbs./day	T - 0.55 I/I- 0.05 C - 0.3 I - 0.1	1977
04016	Lexington STP #2	T4B T4B	27,702 lbs./day	T - 7.0 I/I- 3.2 C -40.0 I -12.0	1977

* T = Treatment, I/I = Inflow/Infiltration
C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

Lexington

The City of Lexington has constructed and operates two major wastewater treatment plants, that are located in different drainage basins. The transfer of wastewater between basins is possible and does occur in some portions of the city. Both plants are located on streams that have a 7-day, 10-year zero flow condition. (For a discussion of Lexington's Hickman Creek Plant, see Segment #25 analysis).

Alternatives for Lexington #1 plant, located on Town Branch appear to be as follows:

(1) Upgrading the existing plant to a T4B treatment level

(2) Pumping of the existing plant effluent to the Kentucky River

(3) Pumping of the existing effluent to an expanded Hickman Creek plant for further treatment.

These alternatives should be considered during 201 Facility Planning.

Midway

The existing wastewater treatment plant for the city is antiquated and overloaded. Alternatives for upgrading the facility include a major reconstruction and rearrangement of existing treatment units or the construction of a new facility entirely. Excessive inflow/infiltration is indicated, however, this will be more adequately determined during 201 Facility Planning.

In the case of both municipalities, as many dischargers as possible should be included in the comprehensive collection system.

SEGMENT #18 ANALYSIS
435.6-51.9-45.3-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 190

Location

Segment #18 begins at the confluence of Cane Run with North Elkhorn Creek, (RM 45.3) and extends to the headwaters of Cane Run. Segment #18 lies in Fayette and Scott Counties.

Basic Planning Data

Segment #18 contains five percent of the City of Lexington and portions of rural Fayette and Scott Counties. The population of the segment was estimated to be 10,451 in 1975 and is projected to increase to 15,553 by 1995.

A small part of the northern half of Lexington lies within Segment #18. The population of this part of Lexington was estimated to be 9,169 in 1965. An increase in population to 13,851 is projected to occur by 1995. The rural farm population in the segment was estimated to be 1,282 in 1975 and is projected to increase to 1,702 by 1995.

Land use in the segment included 33.6 square miles of agricultural land in 1975. During the study period, urban expansion is projected to cause a decrease in agricultural land to 32.7 square miles. The segment also contains some 3.6 square miles of forest and woodland.

Exhibit B.18.1t Basic Planning Data

Segment #18	Projection Years 1970	1975	1980	1995
Population Total	9,601	10,451	11,573	15,553
Rural	1,516	1,282	1,392	1,702
Farm	1,516	1,282	1,392	1,702
Non-Farm	-	-	-	-
Urban	8,085	9,169	10,181	13,851
Housing Unit Total	3,003	3,351	3,831	5,706
Rural	469	403	449	651
Urban	2,534	2,948	3,382	5,055
Land Use (Sq. Mi.)				
Rural				
Agriculture	33.9	33.6	33.4	32.7
Silviculture	3.6	3.6	3.6	3.6
Mining	-	-	-	-
Construction	-	0.3	0.2	0.7
Urban	1.5	1.8	2.0	2.7

Classification

The segment has been classified as Water Quality Limited due to a significant waste load discharged into a stream with zero flow during dry weather periods.

Segment Hydrology

Cane Run lies in the Inner Bluegrass Physiographic Region and has a drainage area of 39.0 square miles.

The average stream slope is 9.6 feet per mile. Hydrology of the stream is effected by the storm water run-off from a portion of the Cities of Lexington and Georgetown. Most of the land is used for agricultural purposes.

Water Quality Data

A water quality sampling data was obtained by Dr. Edward G. Foree.1 Results of the sampling indicate the following average values: D.O. 8.6 mg/1, B.O.D. 1.9 mg/1, pH 8.0, S.S. 16 mg/1, NH3-N 0.6 mg/1 fecal colifrom 636 per 100 ml, P.O. 5mg/1. The sampling station was located at RM 3.0 on Cane Run, a considerable distance below the metropolitan area of Lexington. Based on the information provided above, water quality appears to be satisfactory. EXHIBIT B-18.2t lists standard violations in the segment. It should be noted that the standards violations for Highland Subdivisions are severe.

(1) Assessment of Surface Water Quality in the Lexington, Kentucky Metropolitan Region.

Exhibit B-18.2t Standard Violation

Highland Subdivision STP, (04011); Cane Run Creek

Date	Parameter (mg/1) = Standard/Violation					
	BOD	NH3-N	TSS	DO	P	Other
7/ 8/74	10.0 137.0	2.0 30.8	15.0 61.0	5.0 1.9		
7/22/74	10.0 139.0	2.0 25.7	15.0 46.0	5.0 2.5		
8/ 5/74	10.0 51.0	2.0 20.7	15.0 53.0	5.0 3.8		
8/19/74	10.0 24.0	2.0 11.9		5.0 4.2		

Point Source Dischargers

Significant point source discharges in the segment include; Highland Subdivision near Goergetown, IBM near Lexington, and Vulcan Materials north of Lexington. These are located on EXHIBIT B-3m. All dischargers are shown on EXHIBIT B-18.3t.

Non-point Source Dischargers

Non-point source discharges include storm water run-off from portions of the Cities of Lexington and Georgetown.

Waste Load Allocation and Priority

The total waste load allocation for Highlands Subdivision is 13.3 pounds per day of T.O.D. A breakdown of this allocation is shown on EXHIBIT B-18.4t. The segment priority was calculated using the following factors:

Population	10.6
Severity of Pollution	129.4
Non-point Sources	50.0
Segment Priority	190.0

Municipal Needs

There are no municipal dischargers within the segment however, portions of the Cities of Lexington and Georgetown are located within the segment. A discussion of the municipal needs associated with these cities are set forth in Segment Analysis #16 and #17.

Alternative Water Quality Management Plan

Both the Cities of Lexington and Georgetown have 201 Facility Planning in process. Alternative plans were discussed in Segment Analysis #16 and #17. Specific to this segment is Highland Subdivision that should be incorporated into the municipal system of Georgetown. In the event the 201 Facility Plans for Georgetown indicate that it is not cost effective to incorporate this discharger into the municipal system then Highland Subdivision will be required to upgrade treatment to a T4B level.

Exhibit B-18.3t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
011	Highland Subd. STP	Cane Run		T.F.	0	0.080	88.0	50.0	22.3	
012	I.B.M.	Cane Run		C.W.	0	0.20	-	-	-	
013	Vulcan Material	Cane Run		Pit Water	0	0.34	-	40.0	-	
183	National Guard Armory	UT-Cave Creek		EA & SF	0	0.002	10.0	5.0	1.0	
184	Scott County Trailer Pk.	UT-North Elkhorn Creek		E.A.	0	0.0021	40.0	40.0	8.0	
185	Fayette Mobile Home Park	North Elkhorn Creek		E.A.	0	0.005	40.0	40.0	8.0	
186	Locustwood Ests. Trailer Park	UT-Cane Run Creek		E.A.	0	0.013	40.0	40.0	8.0	
187	Spindletop Farm	UT-Cane Run Creek		E.A.	0	0.010	30.0	30.0	4.0	
188	Kirkdale Mobile Home Park	Cane Run		E.A.	0	0.03	40.0	45.0	8.0	
189	Spindletop Mobile Homes	UT-Cane Run Creek		E.A.	0	0.013	40.0	40.0	8.0	
190	Beltline Thea. Circle #25	UT-North Elkhorn Creek		ST & SF	0	0.005	30.0	30.0	4.0	
336	Ponderosa Mob.Home Pk.	UT-Cane Run		E.A.	0	0.046	40.0	40.0	8.0	

Exhibit B-18.4t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04011	Highland Subdivision	13.4	0.08	10/6.7	15/10.0	1.0/0.7	8.0	6-9 pH	
04012	I.B.M. (C/W)	NA	0.2	NA	NA	NA			
04013	Vulcan Materials	NA	0.34	NA	15/42.5	NA	NA		

SEGMENT #19 ANALYSIS
435.6-96.20/117.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 2.9

Location

Segment #19 extends from Lock and Dam #6 (RM 96.20) to Lock and Dam #7 (RM 117.0) on the main stem of the Kentucky River, a distance of 20.8 River Miles. Portions of Woodford, Jessamine and Mercer Counties are within the segment.

Basic Planning Data

Segment #19 is comprised of 73.27 square miles of rural Mercer, Woodford, and Jessamine Counties. The 1970 population of the segment was estimated to be 2,325 and is projected to increase to 3,205 by 1995.

The restored Shaker community of Pleasant Hill is located in this segment and is attracting increasing numbers of visitors to view this place of Kentucky history.

An estimated 65.2 square miles of Segment #19 is devoted to agriculture and 8.1 square miles are in forest and woodland.

Exhibit B-19.1t Basic Planning Data

Segment #19	Projection Years			
	1970	1975	1980	1995
Population Total	2,325	2,506	2,650	3,205
Rural	2,325	2,506	2,650	3,205
Farm	2,325	2,506	2,650	3,205
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	751	828	899	1,177
Rural	751	828	899	1,177
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	65.2	65.2	65.2	65.2
Silviculture	8.1	8.1	8.1	8.1
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

There are no significant discharges within the segment and the water quality is excellent. The segment is therefore classified as Effluent Limited.

Segment Hydrology

The segment is located in the Inner Bluegrass Physiographic Region. The thalweg slope of the main stem is 0.6 feet per mile and the hydraulic slope is 0.0 feet per mile due to impoundments. The pool elevation is 497.2 feet (MSL). Drainage area within the segment is 72.96 square miles. Drainage area of the basin above the segment is 4,655.4 square miles.

Water Quality Data

Water quality within the segment is excellent since there are no significant dischargers and land use is primarily agricultural in nature.

Point Source Dischargers

There are no significant dischargers in the segment and only two minor dischargers, Shakertown (#125) located on Shaker Creek and the residential treatment facilities located at Kentucky River at Lock and Dam #17 (#126).

Non-point Source Dischargers

Significant non-point source dischargers do not exist.

Waste Load Allocation and Priority

Due to the high quality waters of the segment a waste load allocation has not been assigned. The segment priority was assigned using the following factors:

Population	2.9
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	2.9

Municipal Needs

Municipal needs are not presently required in the segment.

Alternative Water Quality Management Plan

An alternative water quality management plan is not required for the segment except that land application of the effluent from the Shakertown wastewater plant should be considered. Installation of sand or mixed media filter would be an alternative measure.

Exhibit B-19.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
125	Shakertown	Shaker Creek		E.A.	0	0.015	25.0	25.0	4.0	
126	Ky. River Lock & Dam #7	Kentucky River		E.A.	309.7	0.002	25.0	25.0	4.0	

SEGMENT #20 ANALYSIS
435.6-117.4/140.1

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 380

Location

Segment #20 begins at Lock and Dam #7 (RM 117.4) and extends to Lock and Dam #8 (RM 140.1) on the main stem of the Kentucky River and includes all the drainage area between the two points referred to above.

Basic Planning Data

Segment #20 contains the urban communities of Nicholasville and Wilmore and portions of rural Mercer, Jessamine and Garrard Counties. Nicholasville, Jessamine County's largest community, experienced a 26.6 percent increase in population between 1960 and 1970 and this trend can be expected to continue in the future due to the city's close proximity to Lexington. Similarly, Wilmore's population increased 20% from 1960 to 1970, a trend which can be expected to continue.

The urban area of Segment #20 encompassed approximately 3.1 square miles in 1975 and is expected to triple by 1995.

Principal employers in Nicholasville include Adcom Metals Company, manufacturer of bright plating and annealed wire with 40 employees; Hoover Ball and Bearing Company employing 50 persons producing precision steel balls; Nicolet Paper Company, manufacturer of paper and plastic coating material, with 40 employees; Old Fitzgerald Distillery, producer of whiskey, gin and vodka with 125 employees, and Sargent and Greenleaf, manufacturer of locks with 125 employees.

The rural area of Segment #20 is comprised of 74 square miles of agricultural land and 11.2 square miles of forest and woodland.

Exhibit B-20.1t Basic Planning Data

Segment #20	Projection Years			
	1970	1975	1980	1995
Population Total	12,785	15,102	17,878	29,651
Rural	3,490	3,418	3,295	2,435
Farm	3,490	3,418	3,295	2,535
Non-Farm	-	-	-	-
Urban	9,195	11,684	14,583	27,216
Housing Unit Total	3,879	4,733	5,814	10,761
Rural	1,080	1,093	1,095	900
Urban	2,799	3,640	4,719	9,861
Land Use (Sq. Mi.)				
Rural				
Agriculture	74.0	73.2	72.2	67.9
Silviculture	11.2	11.2	11.2	11.2
Mining	-	-	-	-
Construction	-	0.8	1.8	4.3
Urban	3.1	3.9	4.9	9.2

Classification

The segment has been classified as Effluent Limited since the water quality model indicates that discharges within the segment have little or no effect on the main stem. Tributary streams have water quality problems and these will be discussed in the following paragraphs.

Segment Hydrology

The thalweg slope of the main stem is 0.7 feet per mile. The hydraulic slope is 0.0 feet per mile due to impoundments. The 7-day, 10-year low flow of the main stem is 280.39 cfs, therefore the main stem has a high assimilative capacity. The drainage area of the segment is 74.93 square miles and the drainage area above the segment is 4,508.5 square miles. Segment #20 lies within the Inner Bluegrass Physiographic Region.

Water Quality Data

Water quality data on the main stem appears to be excellent. The tributary stream of Jessamine Creek and its tributary stream, Town Branch, receive the effluent from Nicholasville and Asbury College. These dischargers have a significant effect on water quality, EXHIBIT B-20.3t. Additional water quality data will become available as a result of monitoring strategies proposed by the states' continuing plan, that will include a primary and a secondary monitoring station in this segment and in-plant monitoring by the dischargers. For location of monitoring stations see EXHIBIT 3.6m. EXHIBIT B-20.2t lists water quality standards violations. Reference to this EXHIBIT indicated the discharge of the City of Nicholasville is violating standards of B.O.D., D.O., NH3-N, and S.S. All of the minor discharges except #12.8 (Lock and Dam #8) are in violation of applicable treatment standards.

Exhibit B-20.2t Standard Violation

Nicholasville STP, (04038); Jessamine Creek						
Date	Parameter (mg/l) = Standard/Violation					
	BOD	NH3-N	TSS	DO	P	Other
6/10/74	10.0 / 20.0	2.0 / 13.5	15.0 / 41.0	5.0 / 4.0		
6/24/74		2.0 / 1.7	15.0 / 34.0	5.0 / 4.1		
7/ 8/74	10.0 / 40.0	2.0 / 19.0	15.0 / 52.0			
7/22/74	10.0 / 21.0	2.0 / 12.9	15.0 / 30.0			
8/ 5/74	10.0 / 27.0	2.0 / 9.8	15.0 / 47.0	5.0 / 4.1		
8/19/74	10.0 / 32.0	2.0 / 20.0	15.0 / 102.0	5.0 / 4.9		

Point Source Dischargers

The City of Nicholasville, having a capacity of 0.7 MGD discharges into the segment. Other point sources in the segment include: Wilmore STP, Jessamine County High School, and a small discharge on the Kentucky River at Lock and Dam #8. Additional information may be obtained by reference to EXHIBIT B-20-3t on discharge characteristics of the segment. All significant dischargers are located graphically on EXHIBIT B-2m.

Non-point Source Dischargers

There are no significant non-point source dischargers in the segment.

Waste Load Allocations and Priority

Water quality modeling results are indicated in EXHIBIT B-20.4t entitled Waste Load Allocations (1980). The segment priority has been calculated as 380 using the following factors:

Population	13.4
Non-point sources	0.0
Severity of Pollution	366.6
Segment Priority	380.0

The cities of Nicholasville and Wilmore have been assigned construction abatement priorities of 411.1 and 206 respectively. EXHIBIT B-20.5t displays the calculation of these priorities.

Exhibit B-20.5t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Nicholasville)				
Treatment	.184	4.5	247	204.5
I/I	.052	1.5	247	19.5
Collectors	.580	1.0	247	143.3
Interceptors	.184	2.0	247	90.9
Combined Sew.	-	-	-	-
Total Abatement Priority				458

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Wilmore)				
Treatment	.02	4.5	133	12.4
I/I	.006	1.5	133	1.2
Collectors	.787	1.0	133	104.6
Interceptors	.186	2.0	133	49.6
Combined Sew.	-	-	-	-
Total Abatement Priority				167.8

Exhibit B-20.3t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
038	Nicholasville STP	Nicholasville (127.4-9.5-5.3)	Ky. 0020036	Trickling Filter	0	0.7	30.0	28.0	5.4	DO = 3.8
039	Wilmore STP	Wilmore (127.4-5.3-2.2)		E.A.	0	0.5	30.0	30.0	4.0	
127	Jessamine Co. High School	Nicholasville		E.A.	0	0.004	40.0	40.0	8.0	
128	Ky. River Lock & Dam #8	Kentucky River (435.6-140.1)		E.A.	193.1	0.002	25.0	25.0	4.0	

Exhibit B-20.4t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04038	Nicholasville STP	125	0.75	10/63	15/9.4	1.0/6.3	8.0	6-9 pH	458 Ca
04039	Wilmore	17	0.1	10/ 8.3	15/1.3	1.0/0.8	8.0	6-9 pH	168 Ca

Municipal Needs

The City of Nicholasville's municipal wastewater treatment plant was originally constructed in 1939 utilizing a standard rate trickling filter. More recently the plant was expanded and upgraded with a high rate trickling filter process to handle .750 M.G.D. A substantial contributer to the wastewater flow is Adcon Metals Company, which contributes color to the municipal plant's effluent. The industrial wastewater is pretreated for pH control. Color is still an intermittent problem.

Inflow/infiltration problems have been reported as severe, and corrections should be made at an early stage in the upgrading process. Additionally the plant is hydraulically overloaded and it has been reported that this overload exists about 30 percent of the time.

The wastewater plant is located less than 2,200 feet from the main intersection of Nicholasville and urban growth has surrounded the plant, consequently consideration should be given to abandoning the present location. The present plant needs upgrading and /or expanding to a T4B treatment level or a new plant constructed at a new location. (See alternative water quality management plan).

The City of Wilmore has recently completed construction of a new extended activated sludge treatment plant having a capacity of 0.5 M.G.D. There are presently approximately 2,800 people connected with other connections being completed daily. Even though this is a new secondary treatment plant, upgrading to a treatment level of T4B will be required to maintain water quality in Town Branch.

Cost for upgrading and/or construction of new facilities for both cities are listed in EXHIBIT B-20.6t

Exhibit B-20.6t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04038	Nicholas-ville STP	T4B T4B	1,800 lbs./day	T - 0.7 I/I- 0.2 C - 2.2 I - 0.7	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

Nicholasville

Due to hydraulic overloading and close proximity to the urban area, it has been recommended that either a new plant be constructed at the confluence of Town Branch and Jessamine Creek, (RM 9.5) or that the present plant be upgraded and expanded in conjunction with correction of the inflow/infiltration problem. The treatment level required regardless of location is indicated as being T4B.

Wilmore

The City of Wilmore should consider the following alternatives during the 201 Facilities Planning process: (1) upgrading the existing plant to T4B treatment, (2) pumping the effluent from the existing plant ot the Kentucky River, thus negating the requirement for additional treatment, or (3) land application of the secondary effluent. These alternatives should be evaluated on a cost effective basis.

SEGMENT #21 ANALYSIS
435.6-139.9/157.5

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 3.0

Location

Segment #21 lies along the Kentucky River from Lock and Dam #8 (RM 139.9) to Lock and Dam #9 (RM 157.5). Portions of Fayette, Jessamine, Madison, and Garrard Counties are contained within the segment.

Basic Planning Data

Segment #21 contains portions of rural Garrard, Jessamine, Madison and Fayette Counties. The segment is characterized by rural farm development with scattered rural farm settlements including Judson, Stone, Pollard and Spears.

Population in the segment was estimated to be 2,738 in 1970 and is expected to decrease to 2,287 by 1995.

Segment #21 contains an estimated 66.9 square miles of land devoted to agriculture and 12.8 square miles of forest and woodland.

Exhibit B-21.1t Basic Planning Data

Segment #21	Projection Years 1970	1975	1980	1995
Population Total	2,738	2,682	2,635	2,287
Rural	2,738	2,682	2,635	2,287
Farm	2,738	2,682	2,635	2,287
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	859	963	1,111	1,738
Rural	859	963	1,111	1,738
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	66.9	66.9	66.9	66.9
Silviculture	12.8	12.8	12.8	12.8
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

The main stem of the Kentucky River in Segment #21 contains an extremely high 7-day, 10-year low flow and consequently has an enormous assimilative capacity. Therefore, it has been classified as Effluent Limited.

Segment Hydrology

The segment lies within three physiographic regions, Inner Bluegrass, Hills of the Bluegrass and Outer Bluegrass Physiographic Regions. Thalweg slope of the main stem segment is 1.0 feet per mile, hydraulic slope of 0.0 feet per mile due to impoundments. The normal pool elevation is 531.24 feet (MSL). Sugar Creek is the primary tributary contained in the segment. The total segment area is 79.4 square miles and has an upstream drainage area of 3,960 square miles.

Water Quality Data

Available water quality data is insufficient to determine the exact water quality, however, based on data for the sampling station at Lock and Dam #10 and water quality modeling data, water quality in the segment is excellent. D.O. is 8 mg/l or greater, and the pH is 7.8. Water quality monitoring strategies proposed by the Division of Water included the location of a primary monitoring station #048 near (RM 141.13).

Point Source Dischargers

There are no significant or insignificant dischargers in this segment.

Non-point Source Dischargers

Land use is primarily agricultural in nature and therefore no significant non-point source dischargers exist.

Waste Load Allocation and Priority

Since there are no dischargers within the segment, a waste load allocation was not assigned. The segment priority was computed using the following factors:

Population	3.0
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	3.0

Municipal Needs

There are no municipalities within the segment, consequently there are no municipal needs.

Alternative Water Quality Management Plan

The lack of adequate and specific water quality data is apparent. It is recommended that the primary monitoring station as proposed by the Division of Water, Department of Natural Resources be installed to obtain additional data to adequately access water quality in the future. EXHIBIT 3.6m indicates the general location of monitoring stations.

SEGMENT #22 ANALYSIS
435.6-157.5/176.4

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 25.0

Location

Segment #22 is located on the main stem of the Kentucky River and its related tributaries from Lock and Dam #9 (RM 157.5) to Lock and Dam #10 (RM 176.4). Portions of Madison, Fayette and Jessamine Counties are contained in the segment.

Basic Planning Data

Segment #22 is comprised of 23.43 square miles of rural Madison County, 17.25 square miles of rural Fayette County and 26.56 square miles of Clark County. A number of small, rural settlements and linear residential areas are scattered throughout the segment. Population in the segment was estimated to be 3,022 in 1975 and projected to increase slightly to 3,295 by 1995.

The rural area in Segment #22 includes 58.8 square miles of agricultural land and 8.4 square miles of forest and woodland.

Exhibit B-22.1t Basic Planning Data

Segment #22	Projection Years			
	1970	1975	1980	1995
Population Total	2,886	3,022	3,054	3,295
Rural	2,886	3,022	3,054	3,295
Farm	2,886	3,022	3,054	3,295
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	874	933	963	1,130
Rural	874	933	963	1,130
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	58.8	58.8	58.8	58.8
Silviculture	8.4	8.4	8.4	8.4
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

The segment is located on the Kentucky River, which has an adequate flow for waste load assimilation. Therefore, the segment is classified as Effluent Limited.

Segment Hydrology

Segment #22 is located in the Inner Bluegrass and Hills of the Bluegrass Physiographic Regions, and encompasses an area of 67.2 square miles. The upstream drainage area is 3,661 square miles. Thalweg slope of the stream is 0.9 feet per mile, and the hydraulic slope is 0.0 feet per mile. Normal pool elevation is 548.8 feet (MSL).

Exhibit B-22.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
042	Boonesboro Quarry	Kentucky River (435.6-174.7)	Ky. 0001058	Pit Water	188.4	0.24	-	40.0	-	
050	East Kentucky	Kentucky River (435.6-176.4)		C.W.	188.4	72.0	-	-	-	
343	Lexington Water Co.	Kentucky River		S.T.	188.4	0.0008	-	40.0	-	
344	Boonesboro State Park	Kentucky River		E.A.	188.4	0.025	30.0	30.0	4.0	

Exhibit B-22.3t -

Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/1)	Other	
04050	East Ky. RECC	-	72.0	-	-	-	-	-	
04042	Boonesboro Quarry	-	0.25	-	30/63	-	-	6-9 pH	

Water Quality Data

Available water quality data is insufficient to determine specific characteristics, however, according to the Water Quality Modeling Data and meager data from U.S.G.S. Water Quality Records, water quality monitoring strategies proposed by the Division of Water, proposed the installation of a primary water quality monitoring station #049 near (RM 169.0), at the Lexington raw water intake.

Point Source Dischargers

Significant point source discharges include East Kentucky RECC and Boonesboro Quarry. It should be pointed out that neither discharger has a significant oxygen demand. Quarries generally have run-off containing significant suspended solids. Additional monitoring for this parameter should be conducted. EXHIBIT B-22.2t sets forth point dischargers and their related characteristics. The significant point source dischargers are located on EXHIBIT B-4m.

Non-point Source Dischargers

There are no significant non-point source dischargers in this segment.

Waste Load Allocation and Priority

Due to the lack of wastewater requiring an oxygen demand, a waste load allocation was not assigned to this segment. A segment priority was calculated using the following factors:

Population	2.3
Severity of Pollution	22.7
Non-point Sources	0.0
Segment Priority	25.0

Municipal Needs

There are no municipal needs in this segment.

Alternative Water Quality Management Plan

The lack of adequate and specific water quality data necessitates the installation of the proposed primary modeling station #049 for proper evaluation of water quality in the reach of the Kentucky River. EXHIBIT 3.6m indicates the general location of the monitoring station.

SEGMENT #23 ANALYSIS
435.6-176.4/190.8

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 127.8

Location

Segment #23 is located on the main stem of the Kentucky River from Lock and Dam #10 (RM 176.4) to its confluence with the Red River (RM 190.8). The segment lies in Madison and Clark counties.

Basic Planning Data

Segment #23 contains 94.4 square miles of rural Clark County and 79.5 square miles of rural Madison County. Small rural settlements are scattered throughout the 174 square mile segment. The Madison County portion contains some linear residential areas, especially along Kentucky Highway 52 between the small communities of Moberly and Waco. The Lexington Bluegrass Army Depot occupies a significant part of the Madison County portion of the segment and the Central Kentucky Wildlife Area touches the southernmost tip of the segment boundary.

The population of the segment was estimated to be 7,537 in 1975 and is projected to increase to 8,925 by 1995.

The rural area of segment #23 contains an estimated 147.7 square miles of agricultural land and a little over 26 square miles of forest and woodland.

Exhibit B-23.1t Basic Planning Data

Segment #23	Projection Years			
	1970	1975	1980	1995
Population Total	7,330	7,537	7,737	8,925
Rural	7,330	7,537	7,737	8,925
Farm	7,330	7,537	7,737	8,925
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	2,196	2,295	2,396	3,008
Rural	2,196	2,295	2,396	3,008
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	147.7	147.7	147.7	147.7
Silviculture	26.3	26.3	26.3	26.3
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

The main stem of the Kentucky River has a high 7-day, 10-year low flow (180 cfs) and therefore an extremely high assimilative capacity exists. For this reason plus the lack of any significant dischargers in the segment, it is classified as Effluent Limited.

Segment Hydrology

Segment #23 lies in three physiographic regions, Inner Bluegrass, Hills of the Bluegrass, and Outer Bluegrass Physiographic Regions, and has an area of 149.6 square miles. The total upstream drainage area feeding the segment is 3,390 square miles. The major tributaries are Two Mile Creek, Four Mile Creek, Upper Howard Creek, and Muddy Creek. In addition, Otter Creek (Segment #28) empties into Segment #23. The thalweg slope of 0.6 feet per mile and the hydraulic slope of 0.0 feet per mile resulting in a pool elevation of 565.7 feet (MSL).

Water Quality Data

Water quality data is meager for the segment, that which does exist indicates high quality waters within the main stem of the Kentucky River.

Point Source Dischargers

There is one significant discharger in the segment, which is located on EXHIBIT B-4m. All dischargers are shown on EXHIBIT B-23.2t.

Non-point Source Dischargers

There are no significant non-point source dischargers in the segment.

Waste Load Allocation and Priority

A waste load allocation for the Bluegrass Army Depot (#066) has been calculated as 62.6 pounds of T.O.D. per day. Segment priority was calculated using the following factors:

Population	8.2
Severity of Pollution	119.6
Non-point Sources	0.0
Segment Priority	127.8

Municipal Needs

There are no significant municipal dischargers in the segment, therefore municipal needs are not appropriate for this segment.

Alternative Water Quality Management Plan

During the 201 Facilities Planning for the City of Richmond, consideration should be given to the pumping of wastewater generated at the Bluegrass Army Depot to the City of Richmond for treatment. See Segment Analyses #27 and #28. In order to upgrade the existing wastewater treatment facilities of the Army Depot to meet effluent standards, a treatment level of T4B will be required.

Exhibit B-23.2t — Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
066	Bluegrass Army Depot	Muddy Creek		T.F.	0	0.375	35.0	35.0	8.0	
181	Waco School	Waco-Muddy Cr.		E.A.	0	0.006	35.0	35.0	5.0	
132	Estonia Estates	Muddy Creek		E.A.	0.0	0.0018	40.0	40.0	8.0	

Exhibit B-23.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04066	Bluegrass Army Depot	62.5	0.375	10/31.2	15/46.9	1.0/3.1	8.0	6-9 pH	

SEGMENT #24 ANALYSIS
435.6-190.8/201.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 1.0

Location

The reach of the Kentucky River from its confluence with Red River (RM 190.8) to Lock and Dam #11 (RM 201.0) comprises Segment #24 and is located in the Counties of Estill and Madison. The segment area is 16.4 square miles with an upstream drainage area of 3,313 square miles.

Basic Planning Data

Segment #24 contains portions of rural Estill and Madison Counties. Population in the segment was estimated to be 625 in 1970 and is expected to increase slightly by 1995.

Segment #24 contains 7.5 square miles of agricultural land and 8.8 square miles of forest and woodland.

Exhibit B-24.1t — Basic Planning Data

Segment #24	Projection Years			
	1970	1975	1980	1995
Population Total	625	635	647	801
Rural	625	635	647	801
Farm	625	635	647	801
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	184	190	196	250
Rural	184	190	196	250
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	7.5	7.5	7.5	7.5
Silviculture	8.8	8.8	8.8	8.8
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

An Effluent Limited classification has been assigned to the segment due to a 7-day, 10-year low flow of 180.2 cfs, and the absence of a significant waste load.

Segment Hydrology

Segment #24 lies within physiographic region of the Outer Bluegrass and Knobbs. The thalweg slope is 0.7 feet per mile and the hydraulic slope is 0.0 feet per mile due to impoundments. The area of the segment is 16.4 square miles and the drainage area above the segment is 3,313 square miles.

Water Quality Data

Meager water quality data exists for this segment, however due to the lack of significant waste loads and a 7-day, 10-year low flow of 180.2 cfs, a high quality water is assured. A secondary water quality monitoring station has been proposed (station #159) at approximately RM 201.0, (Lock and Dam #11).

Point Source Dischargers

There are no dischargers in this segment.

Non-point Source Dischargers

There are no significant non-point source dischargers in this segment.

Waste Load Allocation and Priority

A waste load allocation was not assigned due to the lack of dischargers. A segment priority was calculated using the following factors:

Population	1.0
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	1.0

Municipal Needs

There are no municipal needs within this segment.

Alternative Water Quality Management Plan

The secondary water quality monitoring station (#159) should assess pH, D.O. Suspended Solids and other parameters associated with the coal industry as will municipal wastewater.

SEGMENT #25 ANALYSIS
435.6-135.3-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 415

Location

Segment #25 is located in parts of Fayette and Jessamine Counties and consists of the Hickman Creek drainage area. Hickman Creek enters the Kentucky River at RM 135.3. A portion of the City of Lexington is located in the drainage area.

Basic Planning Data

Segment #25 contains 50.13 square miles of Jessamine County and 44.82 square miles of Fayette County including approximately 35% of the City of Lexington. The population of the segment was estimated to 67,898 in 1975 and is projected to increase to 100,529 by 1995.

The southeastern portion of Lexington, including the Lexington Reservoir, is contained in Segment #25. The population of this sector of Lexington was estimated to be 64,180 in 1975 and is projected to increase to 96,956 by 1995, being a major growth area in the city.

Segment #25 is comprised of an estimated 74.9 square miles of agricultural land, 7.7 square miles of forest and woodland and 12.3 square miles of urban area. By 1995 an additional 6.4 square miles of agricultural land is projected to be converted to urban land uses.

Exhibit B-25.1t Basic Planning Data

Segment #25	Projection Years			
	1970	1975	1980	1995
Population Total	60,351	67,898	75,069	100,529
Rural	3,752	3,718	3,797	3,573
Farm	3,752	3,718	3,797	3,573
Non-Farm	-	-	-	-
Urban	56,599	64,180	71,272	96,956
Housing Unit Total	18,898	22,009	25,401	38,597
Rural	1,156	1,373	1,723	3,212
Urban	17,742	20,636	23,678	35,385
Land Use (Sq. Mi.)				
Rural				
Agriculture	76.3	74.9	73.5	68.5
Silviculture	7.7	7.7	7.7	7.7
Mining	-	-	-	-
Construction	-	1.4	1.4	5.0
Urban	10.9	12.3	13.7	18.7

Classification

Due to the high waste load presently discharged into Hickman Creek, which is a no flow stream during dry weather periods, Segment #25 is classified as Water Quality Limited.

Segment Hydrology

The segment is located in the Inner Bluegrass Physiographic Region and has an area of 102.7 square miles. East Hickman Creek contains an impoundment in its headwaters for use as a public water supply. Storm water run-off and malfunctioning septic tank systems probably have an effect on segment hydrology and water quality. Limited data regarding this aspect of water quality is available on West Hickman Creek above the surface of the wastewater plant. (See page 40, Assessment of Surface Water Quality in the Lexington, Kentucky Metropolitan Region, by Dr. Edward G. Foree).

Water Quality Data

Water quality data collected and presented in the above referenced report, on page 41, Sampling Station S4-2, indicated the following average values: B.O.D. 5.0 mg/l, D.O. 8.0 mg/l, Fecal Coliform Organisims 356 per 100 ml. It is noteworthy that the sampling station located above the wastewater treatment plant outfall indicates that the fecal coliform parameter was in violation of the water quality standards during each of the sampling periods.

Exhibit B-25.2t Standard Violation

Lexington STP #1, (04041); Hickman Creek

Date	Parameter (mg/l) = Standard/Violation					
	BOD	NH3-N	TSS	DO	P	Other
6/24/74		2.0 10.0				
7/ 8/74			15.0 25.0			
7/22/74		2.0 4.5				
8/ 5/74	10.0 16.0	2.0 10.1				
8/19/74		2.0 4.4	15.0 22.0			

Bluegrass Disposal Corp., (04040); Baughman Creek

Date	Parameter (mg/l) = Standard/Violation					
	BOD	NH3-N	TSS	DO	P	Other
6/10/74	10.0 23.0	2.0 12.1				
7/ 8/74	10.0 26.0	2.0 18.6	15.0 34.0			
7/22/74	10.0 17.0	2.0 11.7		5.0 4.7		
8/ 5/74	10.0 26.0	2.0 8.1	15.0 26.0			

Point Source Dischargers

The two significant point source dischargers in the segment are Lexington's Hickman Creek wastewater plant, (#41) and the Bluegrass Disposal Corporation (#40). EXHIBIT B-25.3t lists all point source dischargers and their respective wastewater characteristics and EXHIBIT B-3m graphically locates the significant dischargers.

Non-point Source Dischargers

Non-point source dischargers consist of storm water run-off from that portion of Lexington contained in the Hickman Creek watershed, including construction projects, malfunctioning private disposal systems, and other extraneous sources associated with large metropolitan areas.

Waste Load Allocation and Priority

The maximum daily T.O.D. load for the segment has been calculated to 1,554.1 pounds per day. A detailed breakdown of the allocation is shown on EXHIBIT B-25.4t. Segment Priority has been assigned using the following factors:

Population	69.1
Severity of Pollution	320.9
Non-point Sources	25.0
Segment Priority	415.0

EXHIBIT B-25.5t lists the calculation of the construction abatement priority for the City of Lexington's Hickman Creek plant.

Municipal Needs

Municipal needs for the City of Lexington are set forth in EXHIBIT B-25.6t. Evaluation of available data indicates that the Hickman Creek plant will meet the treatment levels to maintain water quality standards in Hickman Creek. Additional data will be acquired as a result of continued monitoring.

Alternative Water Quality Management Plan

As previously discussed in the Analysis of Segment #17, Lexington maintains and operates two major wastewater treatment plants. The alternatives discussed in Segment #17 should be considered when preparing the 201 Facilities Plan. Regionialization of all point sources within the greater metropolitan area should be seriosuly considered. Evaluation of available water quality data for other point source discharges, show that they are not meeting acceptable secondary effluent treatment standards. Should it be determined by the 201 Facility Planning process that it is not cost effective to include other point source dischargers into the comprehensive collection system, then it will be necessary for such dischargers to upgrade treatment to the T4B level.

Exhibit B-25.3t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
041	Lexington STP	W. Hickman Cr.		A.S.	0	8.0	8.0	12.0	1.0	
040	Bluegrass Disposal Co.	UT-Hickman Creek		T.F.	0	0.57	21.0	20.0	12.0	
216	Nolans Ashgrove MHP	Wymers Branch		E.A.	0	0.035	40.0	40.0	8.0	
217	Hensley, Robert M.	W. Hickman Cr.		E.A.	0	0.0005	30.0	30.0	4.0	

Exhibit B-25.4t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04041	Lexington STP	1459.5	8.75	10/729.8	15/1095	1.0/73	8.0	6-9 pH	
04040	Bluegrass Disposal Company	95.1	0.57	10/ 47.5	15/ 71.3	1.0/ 4.8	8.0	6-9 pH	

Exhibit B-25.5t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Lexington STP#1)				
Treatment	-	-	-	-
I/I	.029	1.5	188.5	6.7
Collectors	.740	1.0	188.5	139.4
Interceptors	.237	2.0	188.5	89.2
Combined Sew.	-	-	-	-
Total Abatement Priority				235

Exhibit B-25.6t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04041	Lexington STP #1	T4B / T4B	19,391 lbs./day	T - 0 I/I- 0.8 C -25.0 I - 8.0	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #26 ANALYSIS
435.6-170.6-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 67

Location

Segment #26 begins at the junction of Boone Creek and the Kentucky River (RM 170.6) and includes the entire drainage area of Boone Creek. The segment is located in Clark and Fayette Counties.

Basic Planning Data

Segment #26 contains approximately 45 square miles of rural Clark and Fayette Counties with clusters of population scattered throughout the segment in rural farm settlements. Population in the segment was estimated to be 1,592 in 1975 with a projected increase to 2,357 in 1995.

The segment is devoted chiefly to agriculture, with some three square miles in woodland and forest.

Exhibit B-26.1t — Basic Planning Data

Segment #26	Projection Years 1970	1975	1980	1995
Population Total	1,968	1,592	1,765	2,357
Rural	1,968	1,592	1,765	2,357
Farm	1,968	1,592	1,765	2,357
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	624	518	590	857
Rural	624	518	590	857
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	42.1	42.1	42.1	42.1
Silviculture	2.6	2.6	2.6	2.6
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Because of the lack of flow on a 7-day, 10-year low flow frequency, the segment has been classified as Water Quality Limited.

Segment Hydrology

This segment is located in the Inner Bluegrass Physiographic Region of Kentucky. The drainage area of the segment is 44.69 square miles and the main stream slope averages 26.5 feet per mile, which accounts for a high natural reaeration factor.

Water Quality Data

The water quality of Boone Creek is substantially affected by the contribution of wastewater from Baughman Fork. Water quality modeling indicates that B.O.D.-5 and NH3-N water quality parameters are violated during a 7-day, 10-year low flow condition.

Point Source Dischargers

Significant point source discharges are J.F.G. Enterprises and Blue Sky Development Company. All dischargers are listed on EXHIBIT B-26.2t, along with their discharge characteristics. Locations of significant dischargers are shown graphically on EXHIBIT B-3m.

Non-point Source Dischargers

There are no significant non-point source dischargers in the segment.

Waste Load Allocation and Priority

A total maximum waste load for Segment #26 has been calculated at 36.7 pounds of T.O.D. per day. A breakdown of this is shown on EXHIBIT B-26.3t.

Population	1.6
Severity of Pollution	65.4
Non-point Sources	0.0
Segment Priority	67.0

Exhibit B-26.2t — Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l Flow (mgd)	BOD	SS	NH3-N	Other
047	JFG Enterprises	UT-Baughman Fork		EA & L	0	0.060	20.0	20.0	17.0	
048	Blue Sky Develop. Co.	UT-Baughman Fork		CS & L	0	0.120	30.0	30.0	16.0	
303	Iroquois Hunt Club	Boone Creek		S.T.	0	-	40.0	40.0	15.0	
304	B.G. Christian Youth Camp	Boone Creek		E.A.	0	0.010	30.0	30.0	4.0	

Exhibit B-26.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04047	JFG Enterprises	11.7	0.07	10/ 5.8	15/ 8.8	1.0/0.6	8.0	6-9 pH	
04048	Blue Sky Dev. Co.	25.0	0.15	10/12.5	15/18.8	1.0/1.3	8.0	6-9 pH	

Municipal Needs

Due to the absence of municipalities within this segment, there are no municipal needs.

Alternative Water Quality Management Plan

Present dischargers in the segment must upgrade treatment levels to T4B. Consideration should be given to the following alternatives:

(1) Pumping the waste load to the City of Lexington

(2) Piping secondary effluent to the Kentucky River

(3) Providing filtration of the secondary effluent with additional aeration prior to discharge

(4) Constructing holding lagoons for the secondary effluent during periods of critical low flow

(5) Land application of the secondary effluent.

SEGMENT #27 ANALYSIS
435.6-158.1-11.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 390.0

Location

Segment #27 is located in a portion of Madison County and includes Tates Creek and its tributaries. (Tates Creek joins the Kentucky River at RM 158.1). Location of the segment is shown on EXHIBIT B-3m.

Basic Planning Data

Segment #27 contains 31.5 square miles of Madison County including approximately forty percent of the City of Richmond. The population of that portion of Richmond within Segment #27 was estimated to be 7,682 in 1975 and is projected to increase to 12,683 by 1995.

Located within Segment #27 is approximately one half of the campus of Eastern Kentucky University. A coeducational, public institutaion, Eastern has annual enrollments of some 10,000 students.

New residential development on the fringe of Richmond within Segment #27 is occuring in the Barnes Mill Road Area, while extensive commercial development is taking place around the interchange of I-75 and KY 876 and along KY 876 toward Richmond.

In addition to the City of Richmond, Segment #27 contains a number of small, rural settlements. Land use in the segment includes an estimated 22.9 square miles of agricultural land and 7.1 square miles of forest and woodland. The urban area within the segment encompasses approximately 1.5 square miles at present and by 1995 it is projected that an additional square mile of agricultural land will be converted to urban land uses.

Exhibit B-27.1t Basic Planning Data

Segment #27	Projection Years			
	1970	1975	1980	1995
Population Total	8,038	8,990	10,072	13,973
Rural	1,294	1,308	1,316	1,290
Farm	1,294	1,308	1,316	1,290
Non-Farm	-	-	-	-
Urban	6,744	7,682	8,756	12,683
Housing Unit Total	2,245	2,511	2,814	4,109
Rural	361	365	368	379
Urban	1,884	2,146	2,446	3,730
Land Use (Sq. Mi.)	31.5	31.5	31.5	31.5
Rural	30.2	30.0	29.8	29.0
Agriculture	23.1	22.9	22.7	21.9
Silviculture	7.1	7.1	7.1	7.1
Mining	-	-	-	-
Construction	-	0.2	0.2	0.8
Urban	1.3	1.5	1.7	2.5

Classification

Due to the fact that Tates Creek does not have a natural sustained flow during a 7-day, 10-year low flow frequency, and also the fact that a significant discharger exists in Tates Creek, the segment has been classified as Water Quality Limited.

Segment Hydrology

Segment #27 is located in the Knobs and Hills of the Bluegrass Physiographic Regions. The segment area is 35.16 square miles. The average stream slope is 31.4 feet per mile.

Water Quality Data

Meager water quality records exist, however, the water quality model indicates that the D.O. parameter of the stream standards are being violated. Additional data is needed.

Point Source Dischargers

One significant discharger is in the segment, which is the Richmond municipal wastewater treatment plant located on Tates Creek. Dischargers in the segment and their discharge characteristics are shown on EXHIBIT B-27.2t.

Non-point Source Dischargers

Urban run-off from a portion of the City of Richmond constitutes a non-point source of pollution to the segment.

Waste Load Allocation and Priority

The maximum daily T.O.D. load to the segment from the significant discharger is 166.8.(See EXHIBIT B-27.3t) The segment priority was calculated using the following factors:

Population	8.8
Severity of Pollution	371.2
Non-point Sources	10.0
Segment Priority	390.0

The construction abatement priority for the Tates Creek wastewater treatment plant is shown on EXHIBIT B-27.4t.

Municipal Needs

The City of Richmond has two wastewater treatment plants. This one located on Tates Creek (this segment) will need upgrading to a T4B treatment level. In addition, severe inflow/infiltration exists in the collection system. Construction of collectors and inceptors are needed to serve an additional 7,000 people. These municipal needs are set forth in EXHIBIT B-27.5t.

Exhibit B-27.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
046	Richmond STP	Tate Creek		T.F.	0	0.9	30.0	40.0	16.0	
232	Station and Restaurant	Shallow Ford Creek		E.A.	0	0.011	20.0	30.0	4.0	
233	Standard Oil Service Sta.	Shallow Ford Creek		EA & L	0	0.015	20.0	20.0	2.0	

Exhibit B-27.3t

Waste Load Allocations (1980)

Code Number	Faciltiy	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04046	Richmond STP	166.8	1.0	10/83.4	1.0/8.3	1.0/8.3	8.0	6-9 pH	672 Ba

Exhibit B-27.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Richmond STP #2)				
Treatment	.165	4.5	380	282.6
I/I	.050	1.5	380	28.3
Collectors	.620	1.0	380	235.5
Interceptors	.165	2.0	380	125.6
Combined Sew.	-	-	-	-
Total Abatement Priority				672

Exhibit B-27.5t

Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04046	Richmond STP #2	T4B / T4B	1,880 lbs./day	T - 0.4 I/I- 0.12 C - 1.5 I - 0.4	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

The City of Richmond owns and operates two significant municipal wastewater treatment plants. Both will require upgrading to a T4B treatment level to meet water quality standards. The city is also scheduled to conduct a 201 Facilities Plan. During the facilities planning process due consideration should be given to the following alternatives:

(1) Construction of one major wastewater treatment facility to serve the entire community

(2) Upgrade and expand one of the existing facilities to a T4B treatment level to handle the raw waste load that it would normally receive plus the effluent from the other existing plant

(3) Construction of one new treatment plant and upgrading the other to provide a T4B treatment level

(4) Modify the existing collection system to divert a major portion of wastewater to one plant, and through this process lighten the load on one of the existing plants

(5) Various combinations of the above should also be considered

(6) Piping the effluent from secondary (T1A) plants to the Kentucky River which would permit less stringent treatment requirements. Each of these alternatives should be evaluated during the 201 Facilities Planning on a cost effective basis.

SEGMENT #28 ANALYSIS
435.6-177.3-9.3-3.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 495.0

Location

Segment #28 is located in Madison County and includes Otter Creek and its tributaries. Otter Creek flows into the Kentucky River at RM 177.3. Location of the segment is shown on EXHIBIT B-3m.

Basic Planning Data

Segment #28 contains 52.75 square miles of Madison County including sixty percent of the City of Richmond and half of the Eastern Kentucky University Campus. Also within the segment are several small, rural settlements. The southern portion of the segment contains a part of the Lexington Bluegrass Army Depot and the Richmond Airport. The population in the segment was estimated to be 13,731 in 1975 and is projected to increase to 21,303 by 1995.

Population of that portion of Richmond within the segment was estimated to be 11,522 in 1975 and projected to increase to 19,025 by 1995. Residential growth on the fringe of Richmond within the segment is occuring primarily to the north, in the Arlington area.

Principal employers in Richmond include, Beatrice Food's, Kentucky Ice Cream Division, with 55 employees; Okonite, manufacturer of insulated cable with 200 employees; H.K. Porter Company with 239 employees engaged in the manufacture of clutch facings and brake blocks; Robinson Tool and Die with 252 employees; Uncle Charlie's Sausage Company, with 85 employees and the Westinghouse Electric Corporation, with 815 employees producing miniature electric light bulbs.

The rural area of Segment #28 includes an estimated 38.5 square miles of agricultural land and 11.9 square miles of forest and woodland. Urban land area within the segment amounts to approximately 2.3 square miles with an additional 1.4 square miles of agricultural land projected to be given over to urban uses by 1995.

Exhibit B-28.1t Basic Planning Data

Segment #28	Projection Years			
	1970	1975	1980	1995
Population Total	12,303	13,731	15,356	21,303
Rural	2,186	2,209	2,223	2,178
Farm	2,186	2,209	2,223	2,178
Non-Farm	-	-	-	-
Urban	10,117	11,522	13,133	19,025
Housing Unit Total	3,436	3,835	4,289	6,237
Rural	610	617	621	641
Urban	2,826	3,218	3,668	5,596
Land Use (Sq. Mi.)	52.7	52.7	52.7	52.7
Rural	50.7	50.4	50.1	49.0
Agriculture	38.8	38.5	38.2	37.1
Silviculture	11.9	11.9	11.9	11.9
Mining	-	-	-	-
Construction	-	0.3	0.3	1.1
Urban	2.0	2.3	2.6	3.7

Classification

Otter Creek does not have a natural sustained flow on a 7-day, 10-year low flow frequency. Richmond's Otter Creek wastewater treatment plant discharge is on the small stream, thus the segment has been classified as Water Quality Limited.

Segment Hydrology

Segment #28 is located in the Knobs and Hills of the Bluegrass Physiographic Regions. The segment area is 60.48 square miles and the average stream slope is 22.9 feet per mile.

Water Quality Data

Water quality data for Otter Creek is meager, however, the water quality model indicates that the D.O. parameter of the existing stream standards are being violated. Additional data is needed.

Point Source Dischargers

One significant municipal discharger exists in the segment in the form of Richmond's Otter Creek municipal wastewater treatment plant. Dischargers in the segment and their discharge characteristics are shown on EXHIBIT B-28.2t.

Non-point Source Dischargers

Urban run-off from a portion of the City of Richmond constitutes a non-point source of pollution to the segment.

Waste Load Allocation and Priority

The maximum daily T.O.D. load to the segment from the significant discharger is 220.3 pounds per day. (See EXHIBIT B-28.3t). The segment priority was calculated using the following factors:

Population	13.6
Severity of Pollution	456.4
Non-point Sources	25.0
Segment Priority	495.0

The construction abatement priority for the Richmond, Otter Creek wastewater treatment plant is shown on EXHIBIT B-28.4t.

Municipal Needs

Based on the water quality monitoring, the City of Richmond will need T4B treatment. It has been proposed that the existing plant be replaced with an extended aeration plant. Severe inflow/infiltration problems exist in the collection system serving this plant. In addition, interceptors and collector sewers are needed to serve an additional 7,000 people in the Richmond area (See Segment Analysis #27). These municipal needs are set forth in EXHIBIT B-28.5t.

Alternative Water Quality Management Plan

See Segment #27 for alternative water quality management plans.

Exhibit B-28.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Diacharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
049	Richmond STP	Trimble Creek		T.F.	0	1.24	28.0	26.0	16.0	
234	Spurlin Trailer Park	UT-Otter Creek		E.A.	0	0.020	40.0	40.0	10.0	
235	DX Service Station	UT-Otter Creek		ST & SF	0	0.005	5.0	5.0	4.0	
236	Whitehall Elem. School	UT-Trimble Cr.		E.A.	0	0.006	30.0	30.0	8.0	
237	Westinghouse Electric	Otter Creek		C.W.	0	0.001	-	-	-	

Exhibit B-28.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04049	Richmond STP	220.2	1.32	10/110.0	15/165.1	1.0/11.0	8.0	6-9 pH	1160 Ba

Exhibit B-28.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Richmond STP #1)				
Treatment	.385	4.5	470	813.5
I/I	.024	1.5	470	17.4
Collectors	.481	1.0	470	226.0
Interceptors	.110	2.0	470	103.3
Combined Sew.	-	-	-	-
Total Abatement Priority				1160

Exhibit B-28.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04049	Richmond STP #1	T4B / T4B	2,820 lbs./day	T - 2.8 I/I- 0.18 C - 3.5 I - 0.8	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #29 ANALYSIS
435.6-118.2-0.0/3.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 0.1

Location

Segment #29 is located in Garrard and Mercer Counties and consists of Dix River from its confluence with the Kentucky River (RM 0.0) to the Herrington Lake Dam (RM 3.0).

Basic Planning Data

Segment #29 contains 2.86 square miles, comprised of 1.14 square miles of rural Mercer County and 1.72 square miles of rural Garrard County. Population in the segment was estimated to 77 in 1970 and expected to increase only slightly during the planning period.

An estimated 2.4 square miles of the segment is devoted to agriculture and 0.4 square miles to forest and woodland.

Exhibit B-29.1t

Basic Planning Data

Segment #29	Projection Years 1970	1975	1980	1995
Population Total	77	81	86	98
Rural	77	81	86	98
Farm	77	81	86	98
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	26	28	30	37
Rural	26	28	30	37
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	2.4	2.4	2.4	2.4
Silviculture	0.4	0.4	0.4	0.4
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

An augmented flow of 100 cfs occurs during a 7-day, 10-year low flow period from the Dix River Dam. This fact plus the lack of any discharger in the segment has resulted in the classification of Effluent Limited for Segment #29.

Segment Hydrology

The segment lies in the Inner Bluegrass Physiographic Region and has an area of 2.9 square miles. The segment hydrology is influenced considerably by discharge from the impoundment.

Water Quality Data

Meager water quality records indicate: a phosphorus content of 0.11 mh/1, Dissolved Solids 134 mg/1, hardness as Ca and Ma 110 mg/1, specific conductances of 222 microbos, a pH of 8, a temperature of 16°C in the segment with sampling at the damsite. Additional data should be collected within the segment with emphasis on phosphorus.

Point Source Dischargers

There are no point source dischargers in the segment.

Non-point Source Dischargers

There are no significant non-point source dischargers in Segment #29.

Waste Load Allocation and Priority

Due to the lack of dischargers in the segment, a waste load allocation has not been assigned. The segment priority has been calculated as 0.1 based on population.

Municipal Needs

There are no municipalities in Segment #29.

Alternative Water Quality Management Plan

The current water quality monitoring strategy proposes the establishment of a secondary water quality monitoring station (#160) at the Dix River Dam near Burgin, Kentucky. The implementation of this station is recommended with special attention given to phosphorus monitoring.

SEGMENT #30 ANALYSIS
435.6-118.2-3.0/26.2

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 56

Location

Segment #30 is located in portions of Mercer, Garrard, and Boyle Counties, and contains Herrington Lake and related tributaries. The down stream segment boundary begins at its dam (RM 3.0) and the upper boundary is at the confluence with Clark's Run (RM 26.2).

Basic Planning Data

Segment #30 contains the rural non-farm community of Burgin and portions of rural Mercer, Garrard and Boyle Counties. Burgin's population in 1970 was 1,002 and is expected to increase to 1,250 by 1995.

Principal employers in Burgin include the Eatin Corp. manufacturers of climate control components, Mercer Dress Corp, producer of women's dresses and O.K. Precision Tool and Die Company, fabricator of tool die molds.

The rural farm population in this segment was estimated to be 2,488 in 1970 and is expected to decrease to 2,357 by 1995.

Of the 74.3 square miles in Segment #30, an estimated 62.1 square miles is devoted to agriculture and 11.6 to woodland and forest.

Herrington Lake, one of the major recreational Lakes in the Central Bluegrass Region, is located on the Dix River in Segment #30. Providing water related recreational activities for large numbers of people, Herrington Lake can be expected to be even more intensly used in the years ahead. Segment #30 also contains the Kentucky Utility - Burgin power plant.

Exhibit B-30.1t

Basic Planning Data

Segment #30	Projection Years			
	1970	1975	1980	1995
Population Total	3,490	3,766	3,740	3,607
Rural	3,490	3,766	3,740	3,607
Farm	2,488	2,714	2,640	2,357
Non-Farm	1,002	1,052	1,100	1,250
Urban	-	-	-	-
Housing Unit Total	1,156	1,293	1,336	1,373
Rural	1,156	1,293	1,336	1,373
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	62.1	62.1	62.0	61.9
Silviculture	11.6	11.6	11.6	11.6
Mining	-	-	-	-
Construction	-	-	0.1	0.1
Urban	0.6	0.6	0.7	0.8

Classification

Herrington Lake contains a surface area of 2,940 acres and has a capacity of 230,500 acre-feet of water. Considering this volume of high quality water compared to the small influent discharges, the segment has been classified as Effluent Limited.

Segment Hydrology

Location of the segment is within the Inner Bluegrass Physiographic Region, and has an area of 74.3 square miles. The upstream drainage area is 364.8 square miles. Land use is predominately used for agricultural purposes. Pool elevation of the lake is 750 feet (MSL).

Water Quality Data

Based on sampling information developed at the sampling station near the dam site, and described in Segment #29, one must conclude that the water quality is excellent.

Point Source Dischargers

The only significant point source discharge in the segment, is Eastern Kentucky State Hospital which is graphically located on EXHIBIT B-4m. EXHIBIT B-30.2t lists all dischargers and their related effluent characteristics.

Non-point Source Dischargers

There are no significant non-point source dischargers in this segment.

Waste Load Allocation and Priority

Waste load allocations are set forth on EXHIBIT B-30.3t and amount to 16 pounds of T.O.D. per day. The segment priority has been calculated to be 56, using the following factors:

Population	3.7
Severity of Pollution	52.3
Non-point Sources	0.0
Segment Priority	56.0

Municipal Needs

Due to the fact that the segment is without municipalities, municipal needs are not applicable to this segment.

Alternative Water Quality Management Plan

A special effort should be made to monitor and curb phosphorus levels in the lake. All discharges that have effluents into the lake should have phosphorus removal facilities.

Exhibit B-30.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
031	Kentucky State Hospital-East	Herrington Lake		E.A.	-	0.096	30.0	35.0	10.5	
191	Kentucky Utilities	Burgin-Herrington Lake		Ash L.-Cool.Tow.	-	72.0	-	-	-	
192	Caldwell, Richard (Res.)	D.-Herrington Lake		E.A.	-	0.0005	30.0	30.0	4.0	
193	Herrington Haven	Herrington Lake		E.A.	-	0.001	30.0	30.0	4.0	
194	Berry Marina	Herrington Lake		E.A.	-	0.017	30.0	30.0	4.0	
195	Burgin Elem. & High School	UT-Cane Run		E.A.	0.0	0.008	35.0	40.0	8.0	
196	Brown's Cottage Restaurant	Cane Run		E.A.	0.0	0.002	30.0	30.0	4.0	
197	Gasmet Mfg. Company	Cane Run		E.A.	0.0	0.006	30.0	30.0	4.0	
198	Lynn's Restaurant	UT-Mock's Br.		E.A.	0.0	0.001	20.0	20.0	4.0	
199	Blankenship 5 Par Golf Course	UT-Mock's Br.		E.A.	0.0	0.001	30.0	35.0	4.0	
200	Greenview Home Court	UT-Mock's Br.		E.A.	0.0	0.03	40.0	40.0	8.0	
201	Willis E. Stepp (Res.)	Piped to Herrington Lake		E.A.	0	0.001	20.0	30.0	4.0	

Exhibit B-30.3t. - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04051	Kentucky State Hospital	16.0	0.096	10/8.0	15/12.0	1.0/0.8	4.0	6-9 pH	

SEGMENT #31 ANALYSIS
435.6-118.2-326.2-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 1,325

Location

Segment #31 comprises the Clark's Run drainage basin from its confluence with the Dix River (RM 26.2) to its headwaters. The entire segment is contained in Boyle County.

Basic Planning Data

Segment #31 contains 28.77 square miles of Boyle County in which is located the urban community of Danville and the rural non-farm community of Junction City. Danville is the largest city in Boyle County, and in 1970 had a population of 11,542. Danville's population is expected to reach 14,750 by 1995, with the residential growth taking place primarily to the north and east of the city.

Junction City had a population of 1,047 in 1970 and is expected to increase slightly to 1,200 by 1995. Junction City has one major employer, the Penn Ventilator Company, employing 83 persons in the manufacture of ventilating equipment.

Principal employers in Danville include Corning Glass Works which employs 500 people in the manufacture of glass bulbs and tubing; Corps Line, Inc., producer of flagpoles, leather goods and parade products; ; The Danville Advocate - Messenger Company, engaged in offset printing; Genesco, Inc., employing 500 in the manufacture of Ladies shoes; Jackson of Danville, producer of upholstered chairs and sofas; the Palm Beach Company, with 587 employees engaged in the manufacture of mens suits; Reynord, Inc., producers of conveyor belts; Royal Industries, with 60 employees manufacturing friction brake lining and disc pads; the Whirlpool Corp., with 319 employees producing trash compactors; Mid-South Plastic, Inc., with 300 employees producing custom injection molding and Ottenheimer Company, producers of washable service apparel, employing 200 people.

The rural sector of Segment #31 contains an estimated 19.8 square miles of agricultural land and 4.5 square miles of forest and woodland.

Classification

Clark's Run receives a heavy waste load from dischargers around the City of Danville and during dry weather periods, it is a no flow stream. Therefore Segment #31 has been classified as Effluent Limited.

Segment Hydrology

There is meager data available on water quality in Clark's Run, however, the water quality model shows that there are critical problems there, and is in fact one of the most polluted segments in the Kentucky River Basin. Extensive monitoring is mandatory with special attention given to Phorphorus levels. The current water quality monitoring strategy provides for a primary water quality monitoring station (#54) on Clark's Run at stream mile 7.0.

Water Quality Data

Due to the numerous point and non-point sources of pollution, water quality in Clarks Run will frequently be in violation of water quality standards.

Exhibit B-31.1t — Basic Planning Data

Segment #31	Projection Years 1970	1975	1980	1995
Population Total	13,846	14,361	14,847	16,609
Rural	2,304	2,490	2,347	1,859
Farm	1,257	1,429	1,272	659
Non-Farm	1,047	1,061	1,075	1,200
Urban	11,542	11,871	12,500	14,750
Housing Unit Total	4,480	4,918	5,418	6,388
Rural	745	853	856	715
Urban	3,735	4,065	4,562	5,673
Land Use (Sq. Mi.)				
Rural				
Agriculture	19.8	19.7	19.5	18.7
Silviculture	4.5	4.5	4.5	4.5
Mining	-	-	-	-
Construction	-	0.1	0.2	0.8
Urban	4.4	4.5	4.7	5.5

Point Source Dischargers

There are four significant point source dischargers located on Clark's Run and its related tributaries and they are graphically located on EXHIBIT B-5m. In addition, there are numerous small dischargers in the segment. All dischargers and their associated effluent characteristic are shown on EXHIBIT B-31.2t.

Non-point Source Dischargers

There is some agricultural run-off associated with Clark's Run, but the most significant non-point source in the basin is urban run-off from the City of Danville. The extent of this problem is not documented, but it undoubtably has a significant effect on water quality in the stream.

Waste Load Allocation and Priority

The waste load allocation for significant dischargers in Segment #31 are broken down into their contributing factors in EXHIBIT B-31.3t. The priority for Segment #31 was computed using the following factors:

Population	14.2
Severity of Pollution	1,285.8
Non-point Sources	25.0
Segment Priority	1,325.0

Exhibit B-31.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
032	Danville STP	Clark's Run		T.F.	0.0	2.2	40.0	45.0	15.0	
033	Corning Glass	Clark's Run		C.P.	0.0	0.6	10.0	20.0	2.0	
034	Whirlpool Corporation	Clark's Run		C.W.	0.0	-	-	-	-	
035	Caldwell Stone Company	Clark's Run		Pit Water	0.0	0.06	-	40.0	-	
208	Bowlerrama	Clark's Run		E.A.	0.0	0.001	30.0	30.0	4.0	
209	Dexter Bldg.	Clark's Run		E.A.	0.0	0.001	30.0	30.0	4.0	
210	Danville Indus. Foundation	Clark's Run		E.A.	0	0.001	30.0	30.0	4.0	
211	Clearview Subdivision	Clark's Run		E.A.	0.0	0.001	40.0	45.0	8.0	
212	Danville Const. Co.	Clark's Run	Ky. 0000990	Sed.	0	0.0021	-	30.0	-	
213	Collier, Douglas (Res.)	Balls Branch		ST & SF	0	0.001	25.0	40.0	4.0	

Exhibit B-31.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04032	Danville STP	367	2.2	10/183.5	15/275.2	1.0/18.3	8.0	6-9 pH	2109 Ba
04033	Corning Glass	100.1	0.6	10/ 50	15/ 73	1.0/ 5.0	8.0	6-9 pH	
04034	Whirlpool Corp.	C/W	0.21	NA	NA	NA	NA		
04035	Caldwell Stone	Pit Water	0.06	NA	15/ 7.5	NA	NA	6-9 pH	

The construction abatement priority for the municipal collection and treatment facilities in Danville is computed on EXHIBIT B-31.4t.

Exhibit B-31.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Danville)				
Treatment	.122	4.5	1300	716.3
I/I	.061	1.5	1300	119.4
Collectors	.653	1.0	1300	849.0
Interceptors	.163	2.0	1300	424.5
Combined Sew.	-	-	-	-
Total Abatement Priority				2109

Municipal Needs

The present wastewater treatment plant at Danville is served by a 2.2 M.G.D. trickling filter plant providing secondary treatment. This must be upgraded to a higher treatment level or its effluent will cause water quality in Clark's Run to violate stream standards. The collection system in Danville needs to be expanded and presently has excessive inflow/infiltration. Since Herrington Lake is downstream from the effluent, some treatment for phosphorus removal should be added to the treatment process to prevent eutrophication in the lake. Municipal needs for Danville and their associated costs are shown on EXHIBIT B-31.5t.

Exhibit B-31.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04032	Danville STP	T4B** T4B**	2,950 lbs./day	T - 0.6 I/I- 0.3 C - 3.2 I - 0.8	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation.

** Plus Phosphorous Removal

Alternative Water Quality Management Plan

Since Clark's Run has zero flow during dry weather periods, the water quality model has shown that Danville must upgrade to a T4B treatment level in order not to violate stream standards. In addition, phosphorus removal facilities must also be added to the treatment process to insure that eutrophication will not occur in Herrington Lake. The 201 Facilities Plan for Danville should give consideration to various types of treatment technology to achieve the required T4B treatment level including additional stages of trickling filters, sand filters and land disposal. It is also proposed that Junction City install a collection system and pump the wastewater to the Danville plant for treatment.

SEGMENT #32 ANALYSIS
435.6-118.2-26.2/51.1

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 170

Location

Segment #32 consists of the span of the Dix River from its confluence with Herrington Lake (RM 26.2) to the confluence point of the Dix River and Logan Creek. Portions of Boyle, Lincoln, Garrard and Casey Counties are contained in the segment.

Basic Planning Data

Segment #32 contains the Garrard County urban community of Lancaster, the Lincoln County non-farm community of Hustonville and portions of rural Boyle, Lincoln, Garrard and Casey Counties.

Lancaster had a population of 3,230 in 1970 and is expected to increase to 4,450 by 1995. Principal employers in Lancaster include the Cowden-Lancaster Company, which employs 333 in the manufacture of mens and boys work clothing and the National Casket Company, fabricator of steel caskets and employing 245 people.

Hustonville's population in 1970 was 413 and is expected to increase slightly to 465 by 1995. Hustonville has no major manufacturing operations.

The rural sector of segment #32 contains an estimated 109.1 square miles of agricultural land and 36.4 square miles of forest and woodland.

Exhibit B-32.1t Basic Planning Data

Segment #32	Projection Years			
	1970	1975	1980	1995
Population Total	8,874	9,256	9,624	10,413
Rural	5,644	5,830	5,962	5,963
Farm	5,231	5,405	5,523	5,498
Non-Farm	413	425	439	465
Urban	3,230	3,426	3,662	4,450
Housing Unit Total	2,885	3,132	3,409	4,004
Rural	1,798	1,938	2,082	2,293
Urban	1,087	1,194	1,327	1,711
Land Use (Sq. Mi.)				
Rural				
Agriculture	109.1	109.1	108.8	108.4
Silviculture	36.4	36.4	36.4	36.4
Mining	-	-	-	-
Construction	-	-	0.2	0.4
Urban	2.1	2.1	2.3	2.7

Classification

The Dix River in Segment #32 has a 7-day, 10-year low flow of zero and there are significant waste loads discharged into the segment. Therefore, Segment #32 has been classified as Water Quality Limited.

Segment Hydrology

Segment #32 is located in the Hills of the Bluegrass and the Outer Bluegrass Physiographic Regions and contains an area of 147.7 square miles. Major tributaries contained in the segment are Hanging Fork Creek, Harris Creek, Blue Lick Creek, Knobbed Creek, and Gilberts Creek.

Exhibit B-32.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
036	Lancaster STP	White Oak Creek		T.F.	0.0	0.28	40.0	40.0	16.0	
202	Sowder Nursing Home	UT-Dix River		E.A.	0.0	0.0025	40.0	40.0	8.0	
203	Safeguard Corp.	Gilberts Creek		E.A.	0.0	0.0005	30.0	30.0	4.0	
204	Grumbles Trailer Court	Dix River		E.A.	0.0	0.003	40.0	40.0	8.0	
206	Suds & Duds	UT-Dix River		S.T.	0.0	NA	40.0	40.0	8.0	
207	Texas Eastern Transit Co.	UT-Pond-UT-Dix River		ST & SF	0.0	0.0021	10.0	5.0	4.0	

Exhibit B-32.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04036	Lancaster STP	46.7	0.28	10/23.4	15/35.0	1.0/2.3	8.0	6-9 pH	392 Ca

Water Quality Data

There is no water quality data available on this section of the Dix River, however, the water quality model shows the dissolved oxygen sag dropping below 5 mg/l in the segment under existing conditions during dry flow periods. More modeling is needed to keep constant surveillance on the effect of the discharges from Stanford and Lancaster on water quality in the Dix River. The current monitoring strategy provides for a secondary station (#162) on the Dix River below the confluence point with Logan Creek to survey the effect of the Stanford discharge. Additionally, there is provision for a primary monitoring station (#53) at River Mile 34.65 to monitor the water quality after the Dix River has also received Lancaster's discharge.

Point Source Dischargers

The municipal wastewater treatment plant at Lancaster is the only significant discharger in Segment #32. The effluent discharge location is shown graphically on EXHIBIT B-5m. EXHIBIT B-32.2t shows all point sources located in Segment #32 and their respective discharge characteristics.

Non-point Source Dischargers

There is some agricultural run-off in the segment and a small amount of urban run-off. Neither of these source produce a significant effect on water quality in the segment.

Waste Load Allocation and Priority

The waste load and its contributing factors have been computed for the City of Lancaster and they are shown on EXHIBIT B-32.3t. The priority for Segment #32 was computed using the following factors:

Population	9.2
Severity of Pollution	160.8
Non-point Sources	0.0
Segment Priority	170.0

The construction abatement priority for the City of Lancaster is computed on EXHIBIT B-32.4t.

Municipal Needs

The City of Lancaster is presently served by a 0.35 M.G.D. trickling filter. The plant is of sufficient capacity to allow for future growth, but a T4B treatment level is not adequate. The water quality model has shown that a T4B treatment level is necessary to avoid violations of ammonia and dissolved oxygen standards in the receiving stream.

Additionally, there are sewer inflow/infiltration problems in the collection system.

Exhibit B-32.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Lancaster)				
Treatment	.417	4.5	151.3	283.7
I/I	.062	1.5	151.3	14.2
Collectors	.417	1.0	151.3	63.0
Interceptors	.104	2.0	151.3	31.5
Combined Sew.	-	-	-	-
Total Abatement Priority				392

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Hustonville)				
Treatment	.271	4.5	18.7	22.8
I/I	-	-	-	-
Collectors	.581	1.0	18.7	10.9
Interceptors	.148	2.0	18.7	5.5
Combined Sew.	-	-	-	-
Total Abatement Priority				39

The City of Hustonville is presently without a collection system or treatment facilities at the present time, but a 201 Facilities Plan for the area has been approved.

The needs and associated costs for both cities are shown on EXHIBIT B-32.5t.

Alternative Water Quality Management Plan

The water quality model has shown that in order to not violate stream standards in this segment, a T4B treatment level is necessary for the wastewater plant at Lancaster and any future facilities constructed in the Hustonville 201 Facilities Planning area. In the 201 Facilities Plan for Lancaster, due consideration should be given to the various available treatment technologies for upgrading the existing plant to a T4B level. This should include analysis on a cost effective basis of land application, multi-stage filters and filtration. Consideration should also be given to a regionalization process to incorporate all dischargers around Lancaster to the common collection system to be treated by the municipal wastewater faciltiy there. Although it does not appear cost effective, some attention should be given to the feasibiltiy of pumping the effluent from the proposed collection system at Hustonville to the Lancaster wastewater faciltiy for treatment.

Exhibit B-32.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04036	Lancaster STP	T4B / T4B	590 lbs./day	T - 0.8 I/I- 0.12 C - 0.8 I - 0.2	1977
-	Hustonville	T4B / T4B	35 lbs./day	T - 0.5 I/I- 0 C - 0.8 I - 0.2	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #33 ANALYSIS
435.6-118.2-51.1/

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 120

Location

Segment #33 lies in Rockcastle and Lincoln Counties and contains the portion of the Dix River basin from below its confluence with Logan Creek (RM 51.1) to its headwaters.

Basic Planning Data

Segment #33 contains the Lincoln Country urban community of Stanford, the rural non-farm community of Crab Orchard and the Rockcastle rural non-farm community of Broadhead.

Stanford, the principal city in Lincoln County, had a population of 2,474 in 1970 and is expected to increase to 3,112 by 1995. Major employers in Stanford include the Angell Manufacturing Company, producers of metal name plates and metal trim, Cowden-Stanford Company, manufacturer of mens and boys work clothing, and girls and ladies jeans; Stanford Creamery, producer of condensed milk, whey powder and sweet cream; and Stanford Wood Products Inc., manufacturer of wood store fixtures, bank fixtures and plastic liminated furniture.

Crab Orchard's population in 1970 was 861 and is expected to increase only slightly during the planning period. There are no major manufacturing operations in Crab Orchard.

The population of Broadhead was 769 in 1970 and is expected to increase slightly, to 777 by 1995. The major manufacturing employer in Broadhead is the Waste Treatment Division of the Clow Corporation, employing 52 in the production of incinerators and sewage treatment plants.

The rural sector of Segment #33 contains an estimated 118.4 square miles of agricultural land, 60.8 square miles of forest and woodland, and 0.1 square miles of mining activity.

Classification

Due to the lack of dischargers into the main stem of the Dix River, and the fact that dischargers into the tributaries are assimilative by the time they reach the main stem, this segment is classified as Effluent Limited.

Exhibit B-33.1t Basic Planning Data

Segment #33	Projection Years 1970	1975	1980	1995
Population Total	10,426	11,053	11,504	12,744
Rural	7,952	8,478	8,829	9,632
Farm	6,322	6,821	7,145	7,835
Non-Farm	1,630	1,657	1,684	1,797
Urban	2,474	2,575	2,675	3,112
Housing Unit Total	3,257	3,586	3,914	4,882
Rural	2,482	2,745	2,995	3,685
Urban	775	841	919	1,197
Land Use (Sq. Mi.)				
Rural				
Agriculture	118.4	118.3	118.2	117.4
Silviculture	60.8	60.8	60.8	60.8
Mining	0.1	0.1	0.1	0.1
Constructibn	-	-	-	-
Urban	5.9	6.0	6.1	6.9

Segment Hydrology

The 7-day, 10-year low flow of the Dix River in Segment #33 is equal to zero. Logan Creek, Stingy Creek, Walnut Flat Creek, Dranes Creek, Turkey Creek, Copper Creek and Negro Creek are major tributaries contained in the segment which encompasses 185.1 square miles. The segment is located in the Knobs and Hills of the Bluegrass Physiographic Regions.

Water Quality Data

There is extremely limited water quality data this far up into the headwaters of the Dix River, but there are indications that the water quality is quite good.

Point Source Dischargers

The municipal wastewater treatment plant for the City of Stanford is the only significant discharger located in Segment #33. The location of this discharger is shown graphically on EXHIBIT B-5m. A list of all dischargers located in the segment and their respective characteristics are shown on EXHIBIT B-33.2t.

Non-point Source Dischargers

There is some run-off into the water courses of Segment #33 from agricultural and mining activities, however, degradation of water quality due to these sources is not significant.

Waste Load Allocation and Priority

Based on the expected effluent of the treatment level required of the municipal plant at Stanford, a waste load allocation for that discharger has been set at 53.4 pounds per day. A breakdown of this allocation is shown on EXHIBIT B-33.3t. A priority of 166 was

assigned to Segment #33 using the following factors:

Population	10.7
Severity of Pollution	155.3
Non-point Sources	0.0
Segment Priority	166

Exhibit B-33.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
037	Stanford STP	Logan Creek		T.F.	0	0.32	29.0	35.0	15.0	
067	Brodhead	Dix River		E.A.	0	0.15	30.0	30.0	4.0	
214	Green Acres MHP	UT-Logan Cr.		E.A.	0	0.0075	40.0	45.0	15.0	
205	Crab Orchard High School	UT-Dix River		E.A.	0.0	0.0075	30.0	30.0	4.0	
215	Capital City Oil Company	UT-Logan Cr.		E.A.	0	0.0005	20.0	30.0	4.0	

Exhibit B-33.3t Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	Priority
04037	Stanford STP	53.4	0.32	10/26.7	15/40.0	1.0/2.7	8.0		200 Ca
04067	Brodhead STP	25.0	0.15	10/12.5	15/18.8	1.0/1.25	8.0		121 Ca

The computation of the construction abatement priority for wastewater treatment plants in the segment are shown on EXHIBIT B-33.4t.

Municipal Needs

The present wastewater treatment plant at Stanford is served by a 0.32 M.G.D. trickling filter and the collection system has severe inflow/infiltration problems. An additional collection system to serve 600 people will be needed by 1995 and the treatment level of the plant must be upgraded to produce an effluent that will not violate stream standards. Municipal needs and their associated costs for Stanford and the proposed treatment and collection system for Crab Orchard are shown on EXHIBIT B-33.5t.

Exhibit B-33.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Brodhead)				
Treatment	.43	4.5	46	89.0
I/I	.032	1.5	46	2.2
Collectors	.43	1.0	46	19.8
Interceptors	.108	2.0	46	9.9
Combined Sew.	-	-	-	-
Total Abatement Priority				120.94

Exhibit B-33.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Stanford)				
Treatment	.204	4.5	100	91.8
I/I	.122	1.5	100	18.5
Collectors	.490	1.0	100	49.0
Interceptors	.204	2.0	100	40.8
Combined Sew.	-	-	-	-
Total Abatement Priority				200

Exhibit B-33.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Crab Orchard)				
Treatment	.259	4.5	20	23.4
I/I	-	-	-	-
Collectors	.595	1.0	20	11.9
Interceptors	.146	2.0	20	5.8
Combined Sew.	-	-	-	-
Total Abatement Priority				41

The City of Brodhead presently operates a 0.15 MGD extended aeration plant with a design capacity for 1500 people. The system is new and inflow/infiltration problems are slight. The plant must be upgraded to a higher treatment level or stream. Water quality standards in the Dix River will be violated during low flow periods.

Crab Orchard is presently without a collection or treatment system and is in dire need of comprehensive planning. The city has been scheduled for a 201 Facilities Plan. The municipal needs and their related costs for all three municipalities are shown on EXHIBIT B-33.5t.

Exhibit B-33.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04037	Stanford STP	T1A T1A	622 lbs./day	T - 0.25 I/I- 0.15 C - 0.6 I - 0.25	1977
04067	Brodhead	T4B T4B	365 lbs./day	T - 0.4 I/I- 0.03 C - 0.4 I - 0.1	1977
-	Crab Orchard	T4B T4B	190 lbs./day	T - 0.40 I/I- - C - 0.95 I - 0.50	-

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation.

Alternative Water Quality Management Plan

Since Stanford discharges into Logan Creek which is a no-flow stream during the dry season, it must upgrade to a T4B treatment level. The most effective method to achieve this level will probably be to follow the existing plant with a sand filter, however, consideration should be given to other methods such as land disposal.

The 201 Facilities Plan for Stanford and Crab Orchard should give consideration to all available treatment technology to achieve the required T4B treatment levels. Although it does not appear cost effective, some consideration should also be given to regionalization of the two facilities.

The City of Brodhead must also upgrade to a T4B treatment level in order to maintain water quality in the Dix River. Likewise, regionalization should be considered with the City of Crab Orchard but does not appear to be cost effective.

SEGMENT #34 ANALYSIS
435.6-146.0-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 380

Location

Segment #34 is located on Paint Lick Creek, a tributary of the Kentucky River (RM 146.0). The segment is located in portions of Garrard and Madison Counties.

Basic Planning Data

Segment #34 contains an estimated 67.35 square mile of rural Garrard County and 37.12 square miles of Madison County including approximately ten percent of the City of Berea. The 1975 population of the segment was estimated to be 4,135 with an increase to 4,633 projected for the study period.

The population of Berea within Segment #34 was estimated to be 792 in 1975. The population is projected to increase to 1,308 by 1995.

Land use in Segment #34 at present includes 84.9 square miles of agricultural land, 19.2 square miles of forest and woodland, and about 0.4 square miles of urban area. An estimated 0.2 square miles of agricultural land is projected to be converted to urban land by 1995.

Exhibit B-34.1t Basic Planning Data

Segment #34	Projection Years 1970	1975	1980	1995
Population Total	4,046	4,135	4,256	4,633
Rural	3,350	3,343	3,353	3,325
Farm	3,350	3,343	3,353	3,325
Non-Farm	-	-	-	-
Urban	696	792	903	1,308
Housing Unit Total	1,231	1,299	1,395	2,071
Rural	1,037	1,078	1,143	1,686
Urban	194	221	252	385
Land Use (Sq. Mi.)	105.5	104.5	104.5	104.5
Rural	104.1	104.1	104.0	103.8
Agriculture	84.9	84.9	84.8	84.6
Silviculture	19.2	19.2	19.2	19.2
Mining	-	-	-	-
Construction	-	-	0.1	0.2
Urban	0.4	0.4	0.5	0.7

Exhibit B-34.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
043	Berea STP #2	Walnut Meadow Creek		E.A.	0	0.50	30.0	30.0	1.5	
218	Standard Ser. Station	UT-Paint Lick		E.A.	0	0.001	30.0	30.0	4.0	
219	Herd Recre. Vehicle Park	UT-Paint Lick		E.A.	0	0.001	40.0	40.0	8.0	
220	Kirkville Elem. School	Br. Paint Lick Creek		E.A.	0	0.007	40.0	40.0	8.0	
221	Berea College	Walnut Meadow Branch		L	0	0.0021	30.0	45.0	6.0	

Exhibit B-34.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04043	Berea STP #2	83.4	0.5	10/41.7	15/62.6	1.0/4.2	8.0	6-9 pH	662 Ca

Classification

Berea's #2 wastewater plant is located in this segment and to the fact that the stream does not contain natural flow on a 7-day, 10-year, low flow frequency, the segment is classified as Water Quality Limited.

Segment Hydrology

Segment #34 is located in the physiographic regions of Hills of Bluegrass, Knobs, and Mountains and Eastern Coal Fields. The drainage area of the segment is 109.51 square miles. The stream slope is 16.5 feet per mile. Land use is primarily agricultural.

Water Quality Data

Significant water quality data is lacking.

Point Source Dischargers

Berea's wastewater treatment plant #2 is the only significant point source discharge in the segment. The location of this discharge is shown on EXHIBIT B-5m. Existing discharge characteristics of all point sources are listed on EXHIBIT B-34.2t.

Non-point Source Dischargers

Significant non-point source dischargers are non-existant in this segment.

Waste Load Allocation and Priority

A maximum daily waste load allocation of 83.4 pounds of T.O.D. per day has been assigned to the City of Berea's #2 plant. This allocation and proposed effluent characteristics are shown on EXHIBIT B-34.3t.

A segment priority has been calculated using the the following factors:

Population	6.4
Severity of Pollution	373.6
Non-point Sources	0.0
Segment Priority	380.0

A construction abatement priority for Berea's #2 wastewater treatment plan is tabulated on EXHIBIT B-34.4t.

Municipal Needs

The City of Berea has two wastewater treatment plants, one a 1 M.G.D. trickling filter plant located on Silver Creek and the other a 0.5 M.G.D. extended aeration plant located on Walnut Creek. The extended aeration plant is located in Segment #34. Growth is occuring in the area served by the original trickling filter plant. The trickling filter plant is located in Segment #35 and further discussion can be found in that section the report.

The extended aeration plant is located in this segment, the discharge flowing to the Kentucky River via way of Walmut Meadow Creek, a tributary to Paint Lick Creek. Should this plant remain in operation at its present location, the treatment level required will be T4B. There are other alternatives which will be discussed in Segment Analysis #35.

Exhibit B-34.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Berea STP #2)				
Treatment	.160	4.5	380	273.6
I/I	.043	1.5	380	24.5
Collectors	.638	1.0	380	242.4
Interceptors	.160	2.0	380	121.6
Combined Sew.	-	-	-	-
Total Abatement Priority				662

Exhibit B-34.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04043	Berea STP #2	T4B / T4B	750 lbs./day	T - 0.3 I/I- 0.08 C - 1.2 I - 0.3	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Exhibit B-34.5t lists municipal needs and associated costs for the upgrading of this plant to meet the water quality standards.

Alternative Water Quality Management Plan

Berea is located on a ridge between two small drainage basins. Two wastewater treatment plants have been constructed and placed in operation.

The most recently constructed plant is located in this segment, (#34) and discharges into Walnut Meadow Creek, a dry stream under 7-day, 10-year low flow frequency conditions. The other plant, of the trickling filter design, is located on Silver Creek which discharges into Segment #35. This plant is reported to be overloaded both hydraulically and organically. In addition, the City of Berea is expanding in the direction of this older plant and in fact, much development has occured downstream from the trickling filter palnt. It has been proposed that both plants be replaced with one new plant located farther down Silver Creek for treatment of all wastewater originating in the city.

It would appear that other alternatives may include upgrading and expanding the existing extended aeration plant and transferring some of the waste load from the older trickling filter plant to the extended plant. Another possible alternative is land application of secondary effluent.

A 201 Facilities Plan has been scheduled for the City of Berea, a detailed analysis of the city's wastewater treatment facilities is absolutely necessary to determine the most cost effective method of achieving treatment requirements to meet water quality standards.

SEGMENT #35 ANALYSIS
435.6-150.3-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 160

Location

Segment #35 consists of the drainage basin of Silver Creek and runs from its confluence with the Kentucky River (RM 150.3) to the headwaters of the creek. The segment is contained entirely in Madison County.

Basic Planning Data

Segment #35 contains 105.3 square miles of Madison County including approximately 90 percent of the City of Berea. Taylor Fork Lake, the Berea - Richmond Airport and a dozen or so small rural settlements are also located within the segment. The population of the segment was estimated to be 11,554 in 1975 and is projected to increase to 16,138 by 1995.

Berea's population within the segment was estimated to be 7,128 in 1975 and is projected to increase to 11,769 by 1995.

The principal manufacturing employers in Berea include:

- Berea College Industries - 185 employees (furniture, wooden games, fireside brooms)
- Aressen Industries, Valve & Instrument Division 383 employees (pressure gauges)
- Gibson Greeting Card Company, - 279 employees (candles)
- Goodyear Tire & Rubber Company - Industrial Break Operations - 100 employees (industrial brakes)
- Keller Industries, Inc. - 400 employees (aluminum window units, patio doors)
- Parker Seal Company - 592 employees (rubber rings)

Exhibit B-35.1t Basic Planning Data

Segment #35	Projection Years 1970	1975	1980	1995
Population Total	10,649	11,554	12,582	16,138
Rural	4,389	4,426	4,456	4,369
Farm	4,389	4,426	4,456	4,369
Non-Farm	-	-	-	-
Urban	6,260	7,128	8,126	11,769
Housing Unit Total	2,975	3,227	3,515	4,746
Rural	1,226	1,236	1,245	1,285
Urban	1,749	1,991	2,270	3,461
Land Use (Sq. Mi.)	105.2	105.2	105.2	105.2
Rural	102.0	101.6	101.1	99.2
Agriculture	80.5	80.1	79.6	77.7
Silviculture	21.5	21.5	21.5	21.5
Mining	-	-	-	-
Construction	-	0.4	0.5	1.9
Urban	3.2	3.6	4.1	6.0

Exhibit B-35.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
045	Berea STP #1	Silver Creek		T.F.	0	0.9	30.0	35.0	16.0	
044	Brooklyn Subd. STP	UT-Taylor Fork		EA & L	0	0.04	30.0	35.0	12.0	
222	Madison Elem. School	Silver Creek		E.A.	0	0.006	30.0	35.0	10.0	
223	I-75 Rest Area	Between Richmond & Berea, UT-Silver Creek		E.A.	0	0.005	20.0	30.0	120	
224	Fabricating & Assembly Plant	UT-Harts Fork		E.A.	0	0.006	2.0	2.0	4.0	
225	Kingston Elem. School	UT-Hayes Fork		E.A.	0	0.007	30.0	35.0	8.0	
226	Suburban Homes of Kentucky	UT-Silver Creek		E.A.	0	0.004	30.0	40.0	8.0	
227	Bluegrass Army Depot	UT-Hayes Fork		T.F.	0	0.0375	30.0	35.0	12.0	
228	Executive Park Phase #1	Hayes Fork		E.A.	0	0.015	25.0	30.0	2.0	
229	Green Hills Trailer Pk.	Harts Fork		E.A.	0	0.016	30.0	30.0	4.0	
230	Pinnacle View Trailer Park	East Fork Silver Creek		E.A.	0	0.0075	35.0	40.0	12.0	
231	New Warehouse	Burshy Fork		E.A.	0	0.002	30.0	30.0	2.0	

Exhibit B-35.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04045	Berea STP #1	166.8	1.0	10/83.4	15/125.1	1.0/8.3	8.0	6-9 pH	398 Ca
04044	Brooklyn Subd. STP	8.3	0.05	10/ 4.2	15/ 6.3	1.0/0.4	8.0	6-9 pH	

- Suburban Homes of Kentucky, Inc. - 150 employees (prefabricated homes)

The rural area of Segment #35 includes an estimated 80.1 square miles of agricultural land and 21.5 square miles of forest and woodland. Berea's area within the segment amounts to some 3.65 square miles and is projected to increase to 6.0 square miles by 1995.

Classification

Silver Creek has no flow during dry weather periods and there is a large waste load discharged into the creek from Berea and Richmond. For these reasons, Segment #35 has been classified as Effluent Limited.

Segment Hydrology

Portions of Segment #35 lie in three physiographic regions: Hills of the Bluegrass, Outer Bluegrass, and the Knobs. Major tributaries containing the segment include Hays Fork, Harts Fork and Bushy Fork, resulting in a segment area of 122.1 square miles. The 7-day, 10-year low flow of Silver Creek and all of its associated tributaries is equal to zero.

Water Quality Data

There is meager water quality data on Silver Creek, however, the water quality model shows that both dissolved oxygen and ammonia standards are violated during low flow periods.

Point Source Dischargers

There are two significant point source discharges into Silver Creek at the present time which are: Berea wastewater treatment plant #1 and a "package" plant serving Brooklyn Subdivision near Richmond. Both discharge points are graphically located on EXHIBIT B-5m. All discharge points located in Segment #35 are their respective characteristics are shown on EXHIBIT B-35.2t.

Non-point Source Dischargers

There is some run-off from both agriculture in the area and the cities of Berea and Richmond, but neither have a significant effect on water quality in the segment.

Waste Load Allocation and Priority

The waste load allocation and their contributing factors for the significant dischargers in the segment have been computed and are shown on EXHIBIT B-35.3t. A priority of 160 has been assigned to segment #35 and was obtained using the following factors:

Population	10.9
Severity of Pollution	149.0
Non-point Sources	0.0
Segment Priority	160.0

The construction abatement priority for the Berea wastewater treatment plant #1 has been calculated and is shown on EXHIBIT B-35.4t.

Exhibit B-35.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Berea STP #1)				
Treatment	.387	4.5	160	278.6
I/I	.033	1.5	160	7.9
Collectors	.464	1.0	160	74.2
Interceptors	.116	2.0	160	37.1
Combined Sew.	-	-	-	-
Total Abatement Priority				398

Municipal Needs

The municipal needs for Berea are discussed in detail in Segment #34 analysis. The needs and costs for upgrading wastewater plant #1 are shown on EXHIBIT B-35.5t.

Exhibit B-35.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04045	Berea STP #1	T4B / T4B	1,500 lbs./day	T - 2.0 I/I- 0.17 C - 2.4 I - 0.6	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

For a discussion of the water quality management plan for the City of Berea refer to this section of Segment #34 Analysis.

SEGMENT #36 ANALYSIS
435.6-201.0/220.9

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 16

Location

Segment #36 is located on the main stem of the Kentucky River beginning at Lock and Dam #11 (RM 201.0) and extending upstream to Lock and Dam #12 (RM 220.9) The segment is located in the Counties of Estill, Madison and Jackson.

Basic Planning Data

Segment #36 contains the adjacent Estill County communities of Irvine and Ravenna together with rural portions of Estill, Jackson and Madison Counties. Irvine and Ravenna comprise the center of Estill County's growth activity. The combined population of these two communities in 1970 was 3,702 and is expected to increase to 5,526 by 1995.

Residential development is the Irvine-Ravenna area is severly restricted by the steep topography in the area and future residential development is projected to occur in the north section of Irvine.

Chief employers in Irvine are Carhartt, Inc., manufacturer of work clothing and men's outerwear with 373 employees, and the Estill County Pallet Company, producer of wood pallets with 14 employees.

The major employer in Ravenna is the Smyth Lumber Company, fabricator of truck bodies and window and door frames with 16 employees. In addition, the L&N Railraod operates a major switching yard in Ravenna which has the capacity of handling large numbers of coal cars.

Segment #36 is comprised of an estimated 162.5 square miles of agricultural land and 179 square miles of forest and woodland much of which is within the boundaries of the Daniel Boone National Forest.

Exhibit B-36.1t — Basic Planning Data

Segment #36	Projection Years 1970	1975	1980	1995
Population Total	15,233	15,897	16,566	19,052
Rural	11,531	11,909	12,290	13,526
Farm	11,531	11,909	12,290	13,526
Non-Farm	-	-	-	-
Urban	3,702	3,988	4,276	5,526
Housing Unit Total	4,543	4,816	5,253	6,806
Rural	3,404	3,554	3,847	4,745
Urban	1,139	1,262	1,406	2,061
Land Use (Sq. Mi.)				
Rural				
Agriculture	162.5	162.4	162.2	161.7
Silviculture	179.0	179.0	179.0	179.0
Mining	0.1	0.1	0.1	0.1
Construction	-	0.1	0.2	0.5
Urban	1.6	1.7	1.9	2.4

Classification

Classification of the segment is Effluent Limited due to the 7-day, 10-year low flow of 180 cfs and the lack of major waste loads in the segment.

Segment Hydrology

Segment #36 is located in the Knobs and Mountains and Eastern Coal Fields Physiographic Regions. Area contained within the segment is 309.6 square miles with an upstream drainage area of 2,633 square miles. Major tributaries within the segment are; Drowning Creek, White Oak Creek, Cow Creek, and Station Camp Creek. A thalweg slope for the main stem is 0.9 feet per mile and the hydraulic slope is 0.0 feet per mile. The pool elevation is 583.1 feet (MSL).

Water Quality Data

Meager water quality data indicates a high quality water within the segment, and that the D.O. does not fall below 8.0 mg/l during a 7-day, 10-year low flow condition.

Point Source Dischargers

One significant point source discharge, the City of Irvine, exists within the segment. All discharges are listed on EXHIBIT B-36.2t and are graphically shown on EXHIBIT B-5m.

Non-point Source Dischargers

Significant non-point sources do not exist in this segment.

Waste Load Allocation and Priority

The maximum daily T.O.D. load for the City of Irvine has been calculated to be 675.6 pounds per day. The waste load allocation breakdown is shown on EXHIBIT B-36.3t. A segment priority was determined by using the following factors:

Population	16.0
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	16.0

The construction abatement priority for the City of Irvine is tabulated on EXHIBIT B-36.4t.

Municipal Needs

The present wastewater treatment facilities of Irvine Ravenna meet proposed effluent standards, however, the present plant does not have sufficient capacity for 1995 waste loads.

Alternative Water Quality Management Plan

Irvine-Ravenna has been scheduled for completion of 201 Facility Planning. During this process consideration should be given to inclusion of minor discharges into a comprehensive wastewater collection system including the developing areas of South Irvine and West Irvine.

It is reported that the discharge from the existing plant will meet the proposed effluent standards, however, more data should be gathered to validate this report.

Exhibit B-36.2t- Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
005	Irvine STP	Kentucky River (435.6-218.1)	Ky. 0025909	E.A.	181.9	0.6	30.0	30.0	1.5	DO = 4.0
133	West Irvine Elem. School	Irvine UT-Ky. River		ST & SF	0.0	0.008	30.0	35.0	3.0	
134	Estill County High School	Masters Creek		E.A.	0.0	0.0015	35.0	30.0	3.0	
135	Estill County Maintenance	UT-Cow Creek		Pit Water	0	0.0015	10.0	30.0	3.0	
136	Tipton Ridge Stone Co.	Cow Creek		E.A.	0.0	0.045	-	40.0	-	
137	Overgals Mobile Home Park	Crooked Creek		E.A.	0.0	0.0028	40.0	40.0	4.0	
138	South Irvine Elem. School	Station Camp Creek		ST & SF	0.0	0.0026	20.0	5.0	4.0	
348	Southeast Coal Company	UT-Ky. River		L		NA	-	40.0	-	
349	Southeast Coal Company P.C.	UT-Ky. River		E.A.		Size	-	40.0	-	
139	Methodist Camp	Millers Creek		ST & SF	0.0	0.004	20.0	5.0	3.0	
347	Hargett Elem. School	UT-Polecat Cr. Kentucky River		E.A.	0	0.005	28.0	35.0	4.0	
140	Hinkle Const. Co. (AP 800)	Cow Creek		L	0	0.01	5.0	15.0	2.0	
346	Camp Burmawood	Calloway Creek Ky. River		E.A.	0	0.0125	25.0	30.0	3.0	

Exhibit B-36.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04055	Irvine STP	675.6	0.6	30/150.1	30/150.1	20/100	4.0	6-9 pH	20 Ca

Exhibit B-36.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Irvine-Ravenna)				
Treatment	.089	2.0	16	2.8
I/I	.022	1.5	16	0.5
Collectors	.711	1.0	16	11.4
Interceptors	.178	2.0	16	5.7
Combined Sew.	-	-	-	-
Total Abatement Priority				20

Exhibit B-36.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04055	Irvine	TlA TlA	1,105 lbs./day	T - 0.6 I/I- 0.15 C - 4.8 I - 1.2	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #37 ANALYSIS
435.6-220.9/239.9

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 3.6

Location

Segment #37 lies along the main stem of the Kentucky River from Lock and Dam #12 (Rm 220.9) to Lock and Dam #13 (Rm 239.9). Portions of Estill and Lee Counties are within this segment.

Basic Planning Data

Segment #37 is comprised of rural portions of Estill and Lee Counties. The segment is characterized by numerous small, unincorporated rural settlements, none of which is expected to show significant growth during the next twenty years.

An estimated 25.8 square miles of Segment #37 are devoted to agriculture and 88.4 square miles to forest and woodland, some of which is within the boundaries of the Daniel Boone National Forest. In addition, there are numerous oil wells located in the eastern sector of the segment.

Classification

Since there are no dischargers within the segment, a classification of Effluent Limited has been assigned.

Segment Hydrology

The area within the segment consists of 114.2 square miles and includes the following tributary streams, Miller's Creek, Billey Fork, and Buck Creek. The total upstream drainage area is 2,519 square miles. Thalweg slope is 0.9 feet per mile and the hydraulic slope is 0.0 due to impoundments. Pool elevation is 600.1 feet (MSL).

Exhibit B-37.1t Basic Planning Data

Segment #37	Projection Years 1970	1975	1980	1995
Population Total	3,690	3,685	3,754	4,049
Rural	3,690	3,685	3,754	4,049
Farm	3,690	3,685	3,754	4,049
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	1,133	1,172	1,250	1,522
Rural	1,133	1,172	1,250	1,522
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	25.8	25.8	25.8	25.8
Silviculture	88.4	88.4	88.4	88.4
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Water Quality Data

Limited data available from the U.S.G.S. Water Resources Data for Kentucky indicates high quality water in this segment.

Point Source Dischargers

There are no point source dischargers in this segment.

Non-point Source Dischargers

There are no significant non-point source dischargers in this segment.

Waste Load Allocation and Priority

Due to the lack of dischargers in the segment, a waste load allocation was not computed. A segment priority was assigned using the following factors:

Population	3.6
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	3.6

Municipal Needs

Municipal needs are not applicable in this segment.

Alternative Water Quality Management Plan

Alternative water quality management plans are not applicable to this segment.

SEGMENT #38 ANALYSIS
435.6-239.9/249.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 3.4

Location

Segment #38 lies along the Kentucky River beginning at Lock and Dam #13, (RM 239.9) and ending at Lock and Dam #14 near Heidelburg (RM 249.0). Segment #38 is contained in Jackson, Owsley and Lee Counties.

Basic Planning Data

Segment #38 is comprised of rural portions of Lee, Owsley and Jackson Counties. The segment contains numerous small, unincorporated rural settlements, none of which is expected to experience significant growth during the next twenty years. Population in the segment was estimated to be 3,968 in 1970 and is projected to increase slightly to 4,436 by 1995.

Exhibit B-38.1t Basic Planning Data

Segment #38	Projection Years			
	1970	1975	1980	1995
Population Total	3,968	3,923	4,013	4,436
Rural	3,968	3,923	4,013	4,436
Farm	3,968	3,923	4,013	4,436
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	1,184	1,233	1,339	1,678
Rural	1,184	1,233	1,339	1,678
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	37.0	37.0	37.0	37.0
Silviculture	90.5	90.5	90.5	90.5
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Due to the sustained flow during low flow periods and to the lack of dischargers in the segment, this segment has been classified as Effluent Limited.

Segment Hydrology

Segment area includes 125.7 square miles, with an upstream drainage area of 2,657 square miles and contains the following major tributaries; Cave Branch, Sturgeon Creek, Lower Stinking Creek, Upper Stinking Creek, and Black Water Creek. The 7-day, 10-year low flow has been determined to be approximately 178 cfs. Thalweg slope and hydraulic slope are 1.8 feet per mile and 0.0 feet per mile respectively. Pool elevation is 617.9 feet (MSL).

Water Quality Data

Based on limited water quality data available from U.S.G.S. Water Resources Data for Kentucky and water quality modeling, water quality is excellent.

Point Source Dischargers

There are no significant point source dischargers. South Side Elementary School, an insignificant discharger, is located in the segment and its discharge characteristics are presented on EXHIBIT B-38.2t. This discharge location is shown on EXHIBIT B-5m.

Non-point Source Dischargers

Non-point source dischargers are insignificant.

Waste Load Allocation and Priority

Due to the lack of waste loads, a waste load allocation was not calculated. A segment priority was assigned based on the following factors:

Population	3.4
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	3.4

Municipal Needs

Municipal needs are not applicable to this segment.

Alternative Water Quality Management Plan

There are no alternative water quality management plans for this segment.

Exhibit B-38.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
141	South Side Elem. School	Smith Branch		ST & 0.0	0.004	35.0	35.0	5.0		

SEGMENT #39 ANALYSIS
435.6-249.0/255.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 4.0

Location

The span of the Kentucky River from Lock and Dam #14 (RM 249.0) to the confluence point of the main stem of the Kentucky River and the South Fork of the Kentucky River (RM 255.0). Portions of Lee County lie within the basin.

Basic Planning Data

Segment #39 is comprised of approximately 50% of Beattyville and 29.74 square miles of rural Lee County. Beattyville's population in 1970 was 924, an estimated half of which resided in Segment #39. Beattyville's population is expected to remain stable during the planning period.

Chief manufacturing employers in Beattyville include the Brandt Manufacturing Corporation, producers of fiberglass boats and the Lycoming Shoe Company, Manufacturer of women's shoes, employing 200 people.

Segment #39 contains an estimated 5.2 square miles of agricultural land and 24 square miles of forest and woodland, some of which is owned by the Daniel Boone National Forest.

Exhibit B-39.1t — Basic Planning Data

Segment #39	Projection Years			
	1970	1975	1980	1995
Population Total	1,279	1,261	1,249	1,209
Rural	1,279	1,261	1,249	1,209
Farm	817	799	787	747
Non-Farm	462	462	462	462
Urban	-	-	-	-
Housing Unit Total	382	406	429	465
Rural	382	406	429	465
Urban	-	-	-	-
Land Use (Sq. Mi.)	29.7	29.7	29.7	29.7
Rural	29.2	29.2	29.2	29.2
Agriculture	5.2	5.2	5.2	5.2
Silviculture	24.0	24.0	24.0	24.0
Mining	-	-	-	-
Construction	-	-	-	-
Urban	0.5	0.5	0.5	0.5

Classification

Segment #39 has been classified as Effluent Limited due to a sustained 7-day, 10-year low flow and lack of a sufficent discharge to cause degradation of water quality below stream standards.

Segment Hydrology

The Kentucky River in Segment #39 has a thalweg slope of 2.1 feet per mile and a hydraulic slope of 0.0 feet per mile due to impoundments. This results in a normal pool elevation of 634.4 feet (MSL). There are three main tributaries in the segment's 30.3 square miles which are; Contrary Creek, Silver Creek and Crystal Creek. The total upstream drainage area above the segment is 2,831 square miles. A 7-day, 10-year low flow of 178 cfs has been calculated.

Water Quality Data

Limited water quality data taken from the U.S.G.S. Water Resources Data for Kentucky indicates high water quality.

Point Source Dischargers

The only significant discharge in Segment #39 is from the City of Beattyville's extended aeration plant. The location of the discharger is shown on EXHIBIT B-5m and all dischargers in the segment and their related characteristics are listed on EXHIBIT B-39.2t.

Non-point Source Dischargers

The urban run-off from the City of Beattyville probably makes some contribution to degradation of water quality in the segment, however, this effect is minute in contrast to the high flows throughout the segment.

Waste Load Allocation and Priority

EXHIBIT B-39.3t shows the waste load allocation for the City of Beattyville resulting in a maximum total oxygen demand of 152 pounds per day. The priority of Segment #39 was computed using the following factors:

Population	1.7
Severity of Pollution	2.3
Non-point Sources	0.0
Segment Priority	4.0

The computation of the construction abatement priority for the City of Beattyville is tabulated on EXHIBIT B-39.4t.

Exhibit B-39.2t — Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characterisitics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
056	Beattyville STP	Beattyville (255.5)	Ky. 0021121	E.A.	181.0	0.135	32.0	30.0	1.9	
142	Tanner Oil Co. Service	Dry Well Near Beattyville		E.A.	0	0.001	20.0	40.0	3.0	

Exhibit B-39.3t Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04056	Beattyville STP	152	0.135	30/33.8	30/33.8	20/22.5	4.0	6-9 pH	10 Ca

Exhibit B-39.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Beattyville STP)				
Treatment	-	-	-	-
I/I	.091	1.5	4.0	5.5
Collectors	.682	1.0	4.0	2.7
Interceptors	.227	2.0	4.0	1.8
Combined Sew.	-	-	-	-
Total Abatement Priority				10

Municipal Needs

The existing extended aeration wastewater plant, with proper operation, should meet the effluent standards dictated by the regulatory agencies.

Exhibit B-39.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04056	Beattyville STP	T1A / T1A	185 lbs./day	T - 0 I/I- 0.04 C - 0.3 I - 0.1	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

An alternative water quality management plan does not appear to be necessary for the City of Beattyville. As a point of interest, the city does have storm sewers that constitute non-point source waters to the Kentucky River.

SEGMENT #40 ANALYSIS
435.6-190.8-0.0/21.4

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 5.9

Location

Segment #40 begins at the confluence point of the Kentucky River and the Red River (RM 0.0) which is Kentucky River Mile 190.8, and runs to the confluence of the Red River and Brush Creek (RM 21.4). Portions of Powell, Estill, Clark and Montgomery Counties lie within the segment.

Basic Planning Data

Segment #40 is comprised of the Powell County rural non-farm community of Clay City along with 124.4 square miles of rural Powell, Montgomery, Clark and Estill Counties. Clay City's population in 1970 was 983 and is expected to increase to 1,325 by 1995. The rural population of the segment was estimated to be 4,451 in 1970 and is expected to increase to 6,282 by 1995.

Land use in the segment is comprised of an estimated 57.4 square miles of agricultural land and 67 square miles of forest and woodland.

Exhibit B-40.1t Basic Planning Data

Segment #40	Projection Years			
	1970	1975	1980	1995
Population Total	5,534	5,845	6,083	7,607
Rural	5,534	5,845	6,083	7,607
Farm	4,551	4,804	4,983	6,282
Non-Farm	983	1,041	1,100	1,325
Urban	-	-	-	-
Housing Unit Total	1,675	1,838	1,975	2,759
Rural	1,675	1,838	1,975	2,759
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	57.4	57.3	57.2	56.8
Silviculture	67.0	67.0	67.0	67.0
Mining	-	-	-	-
Construction	-	0.1	0.1	0.4
Urban	1.8	1.9	2.0	2.4

Exhibit B-40.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
051	Clay City STP	UT-Red River		E.A.	0	0.19	30.0	30.0	12.5	
053	Tennessee Gas Trans. Co.	UT-Lulbegrud Creek		C.W.	0	0.30	-	-	-	
239	Eastern Ky. Turnpike	Brush Creek		ST & SF	0	0.0007	5.0	5.0	4.0	
240	Hidden Valley Ranch Resort	Lulbegrud Creek		E.A.	0	0.018	10.0	10.0	2.0	
241	Carry Out Burger Hut	Brush Creek		E.A.	0	0.001	20.0	20.0	4.0	
242	Texaco Service Sta.	Brush Creek		E.A.	0	0.0015	20.0	20.0	4.0	
238	Clay City Elem. School	Red River		ST & SF	0	0.0043	30.0	30.0	8.0	

Exhibit B-40.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04051	Clay City STP	33.4	0.2	10/16.7	15/25.0	1.0/1.7	4.0	6-9 pH	8 Ca
04053	Tennessee Gas Trans. Company	C/W	0.3	NA	NA	NA	NA		

Classification

Due to a 7-day, 10-year low flow of approximately 2.8 cfs, and substantial recovery of the stream from previous wasteloads, the segment has been classified as Effluent Limited.

Segment Hydrology

Physiographically, Segment #40 lies in the Knobs and Mountains and Eastern Coal Fields Physiographic Regions and encompasses an area of 126.3 square miles. The major tributary included in the segment is Lulbegrud Creek and the upstream drainage area above Segment #40 is 243.7 square miles. The 7-day, 10-year low flow has been estimated to be 2.8 cfs.

Water Quality Data

Water quality data for this segment, based on water quality modeling, indicates that the stream is in the process of recovery when another waste load is imposed, however, the stream does not degrade significantly and water quality remains satisfactory.

Point Source Dischargers

One significant point source discharge, Clay City (#051), is located in the segment and its discharge location is shown on EXHIBIT B-6m. All dischargers and their discharge characteristics are shown on EXHIBIT B-40.2t.

Non-point Source Dischargers

There are no significant point source dischargers in the segment.

Waste Load Allocation and Priority

The waste load allocation for the wastewater treatment plant at Clay City has been set at 33.4 pounds of total oxygen demand per day based on the results of water quality modeling. A breakdown of waste load allocation for the segment is shown on EXHIBIT B-40.3t. Segment #40 has been assigned a segment priority of 5.9 using the following factors:

Population	5.9
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	5.9

EXHIBIT B-40.4t lists the computation of the construction abatement priority for the city of Clay City.

Exhibit B-40.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Clay City)				
Treatment	.0	-	-	-
I/I	.111	1.5	5.9	1.0
Collectors	.667	1.0	5.9	3.9
Interceptors	.222	2.0	5.9	2.6
Combined Sew.	-	-	-	-
Total Abatement Priority				8

Municipal Needs

The present wastewater treatment facilities meet requirements for T1A treatment. The only additional facilities needed are sewers to serve the addition predicted in population increase and the completion of 201 Facilities Planning. Cost for municipal needs are shown on EXHIBIT B-40.5t.

Exhibit B-40.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04057	Clay City	T1A T1A	265 lbs./day	T - 0 I/I- 0.05 C - 0.3 I - 0.1	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

Alternative water quality management planning should provide for the incorporation of the minor discharges located near the Mountain Parkway, with the comprehensive collection system of Clay City. This alternative should be evaluated during the 201 Facility Planning.

SEGMENT #41 ANALYSIS
435.6-190.8-214/41.1

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 3.0

Location

Segment #41 is located in Powell and Menifee Counties along the Red River from Brush Creek (RM 21.4) to its confluence with the Middle Fork of the Red River (RM 41.1).

Basic Planning Data

Segment #41 contains the Powell County rural non-farm community of Stanton along with portions of rural Powell and Menifee Counties. Stanton's population in 1970 was 2,037 and is expected to more than double by 1995 due in large measure to its close proximity to the Mountain Parkway.

Principal manufacturing employers in Stanton include the Lycoming Shoe Company which employs 200 people in the manufacture of women's shoes and the H.B. Sipple Brick Company with 49 employees.

It is estimated that 15.9 square miles of the segment is in agriculture, 49.7 square miles in forest and woodland, and 2.1 square miles in urban areas, comprising the City of Stanton.

Exhibit B-41.1t Basic Planning Data

Segment #41	Projection Years 1970	1975	1980	1995
Population Total	4,014	4,432	5,199	6,817
Rural	4,014	4,432	5,199	6,817
Farm	1,977	2,038	1,908	2,089
Non-Farm	2,037	2,394	3,291	4,728
Urban	-	-	-	-
Housing Unit Total	4,014	4,432	5,199	6,817
Rural	4,014	4,432	5,199	6,817
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	15.6	15.2	14.3	12.8
Silviculture	49.7	49.7	49.7	49.7
Mining	-	-	-	-
Construction	-	0.4	0.9	1.5
Urban	2.1	2.5	3.4	4.9

Classification

Since the 7-day, 10-year low flow of the Red River near Stanton has been calculated to be above 210 cfs, this should provide sufficient dillution to classify the stream as Effluent Limited.

Segment Hydrology

Segment #41 lies in the Knobs and Mountains and Eastern Coal Fields Physiographic Regions, and encompasses an area of 68.7 square miles. The total upstream drainage area emptying into the segment is 175.0 square miles. During 7-day, 10-year low flow conditions, the Red River has a flow of 2.0 cfs.

Exhibit B-41.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
052	Stanton STP	Red River		E.A.	0	0.15	30.0	30.0	12.5	
243	Sipple Brick Company	Morris Creek		E.A.	0	0.001	20.0	20.0	2.0	
244	Columbia Gulf Gas Trans.	Morris Creek		C.W.	0	0.002	-	-	-	
245	Columbia Gulf Gras Trans.	Morris Creek		E.A.	0	0.005	25.0	20.0	2.0	
130	Powell County High School	Judy Creek-Red River		ST & SF	0	0.0051	30.0	30.0	4.0	
345	Daniel Boone Campground	Red River		E.A.	0	0.0008	30.0	30.0	4.0	

Exhibit B-41.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04052	Stanton STP	35.0	0.21	10/17.5	15/26.3	1.0/1.8	4.0	6-9 pH	4 Ca

Water Quality Data

Based on a 7-day, 10-year low flow of 2.0 cfs, water quality will meet applicable standards. Water quality modeling data indicates that stream standards will be violated within the segment. It should be pointed out however, that the model indicates an instantaneous increase in river flow of 1.413 cfs at RM 17.90. This data appears to be in error. Based on a flow of 2.8 cfs at the gauging station (RM 21.7), a revised flow was computed for the segment. This recomputation indicates satisfactory water quality for the segment.

Point Source Dischargers

The Stanton municipal sewage treatment plant is the only significant discharge in the segment with a capacity of 0.15 M.G.D. All dischargers and their related characteristics are shown on EXHIBIT B-41.2t. EXHIBIT B-6m locates the Stanton municipal discharge.

Non-point Source Dischargers

There are no significant non-point source dischargers in this segment.

Waste Load Allocation and Priority

On EXHIBIT B-41.3t the waste load allocation of 35.0 pounds per day of total oxygen demand for the City of Stanton is broken down into its contributing factors. The priority for Segment #41 of 3.0 was computed using the following factors:

Population	3.0
Severity of Pollution	0.0
Non-point Sources	0.0
Segment Priority	3.0

The construction abatement priority for the City of Stanton is calculated on EXHIBIT B-41.4t.

Exhibit B-41.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Stanton)				
Treatment	.188	1.5	3.0	.8
I/I	.031	1.5	3.0	.1
Collectors	.625	1.0	3.0	1.9
Interceptors	.156	2.0	3.0	.9
Combined Sew.	-	-	-	-
Total Abatement Priority				4

Municipal Needs

The existing extended aeration plant will need additional capacity to serve 2,300 additional people. Also collection and sewers will be needed in conjunction with this increase in capacity. A 201 Facilities Plan will be necessary including an evaluation of inflow/infiltration.

Exhibit B-41.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04052	Stanton	T1A T1A	946 lbs./day	T - 0.6 I/I- 0.1 C - 2.0 I - 0.5	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

Should it become necessary to increase the treatment level of the Stanton plant, consideration of land application of the secondary effluent should be evaluated on a cost effective basis. All minor wastewater dischargers should be incorporated in the municipal system on a cost effective basis whenever possible.

SEGMENT #42 ANALYSIS
435.6-190.8-41.1/59.5

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 40.0

Location

Segment #42 is located in Powell, Menifee and Wolfe Counties and stretches along the Red River from its confluence with the Middle Fork of the Red River (RM 41.1) to the confluence point of Red River and Swift Camp Creek (RM 59.5).

Basic Planning Data

Segment #42 contains 154.8 square miles of rural portions of Menifee, Wolfe and Powell Counties. Aside from a few small, rural settlements, the segment is characterized as primarily Daniel Boone National Forest land. There are a number of oil and gas wells in the northern half of the segment and along the southern portion of the segment boundary. Segment #42 also contains Natural Bridge State Park, a major tourist and recreational facility in the region.

In 1975, the population of the segment was estimated to be 3,421, with only a slight increase projected to occur during the study period.

The rural area of Segment #42 included 121.3 square miles of forest and woodland, and 33.5 square miles of agricultural land.

Exhibit B-42.1t Basic Planning Data

Segment #42	Projection Years 1970	1975	1980	1995
Population Total	3,389	3,421	3,434	3,482
Rural	3,389	3,421	3,434	3,482
Farm	3,389	3,421	3,434	3,482
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	982	1,033	1,087	1,249
Rural	982	1,033	1,087	1,249
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	33.5	33.5	33.5	33.5
Silviculture	121.3	121.3	121.3	121.3
Mining	-	-	-	-
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Due to a small but sustained low flow during dry weather periods and assimilation of the City of Campton's wastewater discharge by Swift Camp Creek before emptying into the main stem of the Red River, this segment is classified as Effluent Limited. However, severe water quality problems exist on Swift Camp Creek.

Segment Hydrology

Segment #42 is located in the Mountains and Eastern Coal Fields Physiographic Region. The average stream slope is 14.7 feet per mile and the segment contains 108.01 sq.mi. of drainage area. Tributaries within the segment are Mill Creek and Middle Fork of Red River.

Water Quality Data

Water quality in the segment is good based on water quality modeling, however, due to the entrance of Swift Camp Creek at River Mile 59.9 which contains the effluent from Campton, water quality is affected in the upper reaches of the segment. Stream standards are not violated during 7-day, 10-year low flow conditions in the Red River, however, it should be pointed out that water quality standards are violated in Swift Camp Creek. To monitor this problem, the present water quality management strategy has provided two secondary monitoring stations, one just above Station Camp Creek (#164) and one just below the confluence point (#163).

Point Source Dischargers

One significant point source discharge exists in the segment, the City of Campton's wastewater treatment plant effluent. All dischargers in the segment are listed on EXHIBIT B-42.2t, along with their discharge characteristics. Significant point source locations are shown on EXHIBIT B-6m.

Non-point Source Dischargers

There are no significant non-point source dischargers in the segment.

Exhibit B-42.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
054	Campton STP	Swift Camp Ck.		E.A.		0.10	30.0	35.0	10.5	
246	Natural Bridge State Park	Middle Fork Red River		E.A.		0.008	30.0	30.0	2.0	
247	Natural Bridge Lodge Area	Middle Fork Red River		E.A.		0.008	30.0	30.0	2.0	
248	Dessie Scott Children's H.	Mill Creek		E.A.		0.0035	35.0	40.0	8.0	
249	Red River Valley Elem. School	UT-Red River		E.A.		0.006	35.0	40.0	8.0	
250	Sewells Laundry (Davis Boro)	Red River		L.		0.0021	45.0	40.0	4.0	
251	Campton Elem. School	Swift Camp Cr.		E.A.		0.005	40.0	40.0	8.0	
252	Wolfe County High School	Swift Camp Cr.		E.A.		0.0021	40.0	40.0	8.0	
253	Standard Oil Co. Ser. Sta.	Swift Camp Cr.		E.A.		0.001	20.0	20.0	4.0	
254	Mt. Parkway Rest Area	Hiram Branch		E.A.		0.002	25.0	25.0	1.0	

Exhibit B-42.3t -

Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04054	Campton STP	16.7	0.1	10/8.3	15/12.5	1.0/0.8	8.0	6-9 pH	87 Ca

Exhibit B-42.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Campton)				
Treatment	.286	4.5	40	51.5
I/I	.057	1.5	40	3.4
Collectors	.514	1.0	40	20.6
Interceptors	.143	2.0	40	11.4
Combined Sew.	-	-	-	-
Total Abatement Priority				87

Exhibit B-42.5t

Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04054	Campton STP	T4B / T4B	116 lbs./day	T - 0.1 I/I- 0.02 C - 0.18 I - 0.05	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Waste Load Allocation and Priority

A maximum waste load allocation of 16.7 pounds per day of T.O.D. was assigned to the City of Campton, the significant discharger. The segment priority was calculated using the following factors:

Population	3.0
Severity of Pollution	37.0
Non-point Sources	0.0
Segment Priority	40.0

The construction abatement priority for the City of Campton is shown on EXHIBIT B-42.4t.

Municipal Needs

The municipality has a 0.1 M.G.D. extended activated sewage plant with adequate capacity, however, through the use of water quality modeling, a treatment level of T4B will be required to meet stream standards. Upgrading the plant with sand filtration equipment or a similar facility will satisfy T4B requirements. Additional inflow/infiltration problems exist, thus requiring a 201 Facilities Plan. Municipal Need and associated costs are shown on EXHIBIT B-42.5t.

Alternative Water Quality Management Plan

Water quality management plans should include the evaluation of land application of the secondary wastewater plant effluent as an alternative to upgrading with mechanical facilities. During 201 Facilities Planning, consideration should also be given to comprehensive wastewater systems where it is cost effective. Reduction of inflow/infiltration will in essence reduce the plant hydraulic loading resulting in a higher quality effluent and prolonged adequacy of the treatment system.

SEGMENT #43 ANALYSIS
435.6-190.8-59.9/

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 3.0

Location

Segment #43 includes the Red River from its confluence point with Swift Camp Creek (RM 59.5) to its headwaters. Portions of Menifee and Wolfe lie within this segment.

Basic Planning Data

Segment #43 contains the rural non-farm community of Campton and 145.36 square miles of rural Wolfe and Menifee Counties. The population in the segment was estimated to be 3,709 in 1975. An increase to 3,902 is projected to occur by 1995.

Campton is in the Wolfe County portion of the segment. Its 1975 population was estimated to be 419 with a projected increase in population to 578 during the study period.

The principal manufacturing employer in Campton is Computer Peripherals, Inc., producer of computer wire preparations and cabling. Computer Peripherals employed 245 persons in 1974.

The rural area of Segment #43 includes an estimated 37.1 square miles of agricultural land and 107.2 square miles of forest and woodland. The northwest quarter of the segment is within the Daniel Boone National Forest.

Exhibit B-43.1t Basic Planning Data

Segment #43	Projection Years			
	1970	1975	1980	1995
Population Total	3,742	3,709	3,753	3,902
Rural	3,742	3,709	3,753	3,902
Farm	3,323	3,290	3,298	3,324
Non-Farm	419	419	455	578
Urban	-	-	-	-
Housing Unit Total	1,087	1,148	1,252	1,497
Rural	1,087	1,148	1,252	1,497
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	37.1	37.1	37.0	36.7
Silviculture	107.2	107.2	107.2	107.2
Mining	0.1	0.1	0.1	0.1
Construction	-	-	0.1	0.3
Urban	0.9	0.9	1.0	1.3

Classification

Due to the lack of dischargers, this segment is classified as Effluent Limited.

Segment Hydrology

Physiographically, Segment #43 lies in the Mountains and Eastern Coal Fields Region, containing an area of 63.1 square miles. The 7-day, 10-year low flow for the segment approaches zero and the average stream slope is 7.5 feet per mile. Major tributaries contained in the segment are, Stillwater Creek, Big Branch Creek, Lacy Creek, Gillmore Creek, and Greenbriar Branch.

Water Quality Data

Meager water quality data is available for the segment. Due to the lack of significant point and non-point sources, water quality should be excellent. Additional monitoring of the waters of this segment is needed. The present Water Quality Management Strategy has provided for a primary water quality monitoring station (#055) on the Red River near Hazel Green (RM 73.32).

Point Source Dischargers

There are no point source dischargers existing in the segment at the present time.

Non-point Source Dischargers

Under existing conditions, water quality is not affected by non-point source dischargers in the segment.

Waste Load Allocation and Priority

Since there are no existing dischargers in Segment #43, a waste load allocation has not been computed. The segment priority was computed directly using the

population of the segment as the only applicable parameter. The segment priority is 3.0.

Exhibit B-43.2t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Hazel Green)				
Treatment	.336	4.5	1.9	2.9
I/I	-	-	-	-
Collectors	.531	1.0	1.9	1.0
Interceptors	.133	2.0	1.9	0.5
Combined Sew.	-	-	-	-
Total Abatement Priority				4

Municipal Needs

The City of Hazel Green does not have a wastewater collection and disposal system. A 201 Facility Plan has been proposed.

Alternative Water Quality Management Plan

An alternative water quality management cannot be properly evaluated until the 201 Facilities Plan has been initiated.

SEGMENT #44 ANALYSIS
435.6-254.8-0.0/45.1

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 22.6

Location

Segment #44 consists of the South Fork of the Kentucky River from its confluence point with the main stem of the Kentucky River (RM 0.0) to its confluence point with the Redbird River (RM 45.1). Portions of Jackson, Clay, Owsley, Leslie and Lee counties lie within this segment.

Basic Planning Data

Segment #44 contains the rural non-farm community of Booneville in Owsley County, and a little over 297 square miles of rural Owsley, Lee, Clay, Leslie and Jackson Counties. Jackson and Lee Counties are minor contributors to the area of the segment; Owsley and Clay together contribute 275.64 square miles. The segment can be described as principally forest with scattered rural settlements. The southern part of the segment contains a number of gas wells and small sections of the Daniel Boone National Forest. The population of the segment was estimated to be 8,845 in 1975, and is projected to decline to 8,339 during the study period.

Booneville had a 1970 population of 126 with no significant change in population projected for the study period.

The rural area of Segment #44 contains an estimated 233.9 square miles of forest and woodland, and 63 square miles of agricultural land.

Exhibit B-44.1t Basic Planning Data

Segment #44	Projection Years 1970	1975	1980	1995
Population Total	8,604	8,845	8,763	8,339
Rural	8,604	8,845	8,763	8,339
Farm	8,478	8,719	8,637	8,213
Non-Farm	126	126	126	126
Urban	-	-	-	-
Housing Unit Total	2,486	2,567	2,694	2,966
Rural	2,486	2,567	2,694	2,966
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	63.0	63.0	63.0	63.0
Silviculture	233.9	233.9	233.9	233.9
Mining	0.1	0.1	0.1	0.1
Construction	-	-	-	-
Urban	0.1	0.1	0.1	0.1

Classification

Due to a small but sustained low flow on the South Fork of the Kentucky River, plus the totally assimilated wastewater from dischargers upstream, there is enough flow through the segment to assimilate the discharge from the municipal wastewater plant at Booneville during all periods of the year. For this reason, Segment #44 is classified as Effluent Limited.

Segment Hydrology

Segment #44 is located in the Mountains and Eastern Coal Fields Physiographic Region and encompasses an area of 297.1 square miles. The average stream slope of this segment of the South Fork of the Kentucky River is 3.0 feet per mile and the 7-day, 10-year low flow is 0.06 cfs. Major tributaries of the segment are Cow Creek, Indian Creek, Meadow Creek, Buffalo Creek, and Septon Creek.

Water Quality Data

Meager water quality data is available for this segment, however, water quality modeling data indicates that the present treatment level will meet stream standards although the discharge does affect water quality somewhat, particularly the D.O. Strategies for water quality monitoring proposes the installation of a secondary monitoring station (#165) at or about RM 12.0 near Booneville. This station should be programmed to determine B.O.D., D.O., pH, S.S., and other parameters associated with mineral extraction and the wastewater effluents.

Point Source Dischargers

The only significant point source discharger in Segment #44 is the municipal wastewater treatment plant at Booneville. EXHIBIT B-7m graphically locates the discharger and EXHIBIT B-44.2t lists all dischargers in the segment and their respective effluent characteristics.

Exhibit B-44.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
064	Booneville STP	South Fork Kentucky River		E.A.	0.07	0.070	30.0	30.0	1.5	
278	Lee County Maint. Garage	Long Branch		E.A.	0	0.001	25.0	25.0	4.0	
279	G.P. Congleton Five Family Restaurant	South Fork Kentucky River		E.A.	0.6	0.033	25.0	30.0	4.0	
280	Congleton Children's Home	Long Branch		E.A.	0	0.0025	40.0	40.0	8.0	
281	Etowah Manufacturing	South Fork Kentucky River		E.A.	0.6	0.005	20.0	30.0	4.0	
282	Onida Baptist Institute	South Fork Kentucky River		E.A.		0.014	30.0	30.0	4.0	

Exhibit B-44.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04064	Booneville STP	12.5	0.075	10/6.3	15/9.4	1.0/0.6	8.0	6-9 pH	19 Ca

Non-point Source Dischargers

The water quality of the South Fork has been degraded during recent years due primarily to mining related problems. It receives both acid drainage, orphaned mines, sediment and siltation from newly disturbed areas.

Waste Load Allocation and Priority

Based on the required treatment level and the resulting effluent, a waste load allocation for the City of Booneville has been set at 83.7 pounds of T.O.D. per day. A priority of 22.6 has been assigned to the segment and was calculated using the following factors:

Population	12.6
Severity of Pollution	0.0
Non-point Sources	10.0
Segment Priority	22.6

The construction abatement priority for the City of Booneville is computed in EXHIBIT B-44.4t.

Exhibit B-44.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Booneville)				
Treatment	-	-	-	-
I/I	.048	1.5	20.4	1.5
Collectors	.571	1.0	20.4	11.6
Interceptors	.143	2.0	20.4	5.8
Combined Sew.	-	-	-	-
Total Abatement Priority				19

Municipal Needs

The present treatment facility is believed to be sufficient to maintain water quality standards with proper operation. A 201 Facility Plan has been proposed for the area. It has been suggested that the community of Levi be added to the Booneville system to serve approximately 60 customers. EXHIBIT B-44.5t sets forth the cost of providing the necessary needs.

Exhibit B-44.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04064	Booneville	T1A T1A	25 lbs./day	T - 0 I/I- 0.02 C - 0.24 I - 0.06	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

The inclusion of the community of Levi into the Booneville comprehensive collection system should be considered on a cost effective basis during 201 Facility Planning. Minor dischargers within reach of the comprehensive system should also be included.

SEGMENT #45 ANALYSIS
435.6-258.6-0.0/43.26

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 14.8

Location

The stretch of the Middle Fork of the Kentucky River from its confluence with the North Fork of the Kentucky River to the Buckhorn Lake Dam (RM 43.26) is the boundary of Segment #45. This area lies in portions of Lee, Breathitt, Owsley and Perry Counties.

Basic Planning Data

Segment #45 contains 168.10 square miles comprised of rural Lee, Breathitt, Perry and Owsley Counties. Population in the segment in 1970 was estimated to be 4,890 and is expected to increase slightly to 4,969 by 1995.

Land use in Segment #45 is estimated at 20.2 square miles of agricultural land, 147.5 square miles of forest and woodland, and 0.4 square miles of mining activity.

Exhibit B.45.1t Basic Planning Data

Segment #45	Projection Years 1970	1975	1980	1995
Population Total	4,890	4,846	4,899	4,969
Rural	4,890	4,846	4,899	4,969
Farm	4,890	4,846	4,899	4,969
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	1,354	1,420	1,538	1,909
Rural	1,354	1,420	1,538	1,909
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	20.2	20.2	20.2	20.2
Silviculture	147.5	147.5	147.5	147.5
Mining	0.4	0.4	0.4	0.4
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Due to a 7-day, 10-year low flow of 150 cfs from the reservoir and a lack of a significant waste load, the segment has been classified as Effluent Limited.

Segment Hydrology

Physiographically, Segment #45 is located in the Mountains and Eastern Coal Fields Region, and contains an area of 165.5 square miles. The upstream drainage area emptying into the segment is 389.0 square miles and the resulting 7-day, 10-year low flow of 150 cfs is due principally to low flow augmentation from Buckhorn Lake.

Water Quality Data

Considerable data exists in Storet Water Quality Data Files for Waters within the Reservoir, however, only one sampling station of the nineteen stations lists water quality data below the dam. Based on this data, water quality appears to be of high quality. It should be pointed out that water quality downstream from the dam can be significantly affected by the reservoir. Release of waters from near the bottom of the reservor will be low in D.O., high in iron and manganese. Phosphorus is not a problem in the reservoir waters. Water quality monitoring

Exhibit B-45.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l Flow (mgd)	BOD	SS	NH3-N	Other
292	Buckhorn Elem. School	Squabble Creek		E.A.	0	0.005	40.0	40.0	8.0	
293	Buckhorn Childrens Center	Squabble Creek		E.A.	0	0.0009	40.0	40.0	8.0	

strategies propose the installation of two secondary monitoring stations, one, (#167) located at approximately RM 8.5 and the other (#168) located at approximately RM 43.1. These two stations shown provide sufficient data to assess effluent water quality of the reservoir. Both stations should be programmed to monitor water quality parameters associated with mineral extraction activities. In addition, these stations, which are down stream of the dam should monitor D.O. and release of reservoir waters into the segment should be managed in such a manner as to avoid violation of water quality standards. EXHIBIT 3.6m graphically indicates the location of the proposed monitoring stations.

Point Source Dischargers

There are no significant point source dischargers located within the segment. The effluent characteristics of all small dischargers located in Segment #45 are shown on EXHIBIT B-45.2t.

Non-point Source Dischargers

There are a few scattered strip mines located in the segment which sometimes produces siltation in the streams of Segment #45.

Waste Load Allocation and Priority

Since there are no significant dischargers located within the segment, no waste loads could be computed. The priority of the segment was computed using the following factors:

Population	4.8
Severity of Pollution	0.0
Non-point Sources	10.0
Segment Priority	14.8

Municipal Needs

There are no municipal wastewater treatment facilities presently existing in Segment #45 so municipal needs are not applicable to this segment.

Alternative Water Quality Management Plan

It is recommended that a cooperative management plan be developed between the U.S. Army Corps of Engineers and the Commonwealth of Kentucky related to the release of waters from the reservoir to the extent that only high quality waters will be released during periods of low flow. This would be aimed at degradation of segment waters. Consideration should also be given to changing the designated secondary water quality monitoring station (#168) to a primary station for more adequate collection of data.

SEGMENT #46 ANALYSIS
435.6-238.6-43.26/60.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 16.8

Location

Buckhorn Lake and its related tributaries comprise Segment #46 which runs from the Buckhorn Lake Dam (RM 43.26) to the headwaters of the lake (RM 60.0). The segment is contained in Perry and Leslie Counties.

Basic Planning Data

Segment #46 contains portions of rural Perry and Leslie Counties. Population in the segment was estimated to be 1,855 in 1970 and is expected to decline to 1,559 by 1995.

Located within the segment is the 1,200 acre Buckhorn Reservoir in which is located the Buckhorn Lake State Park with lodge and marina facilities.

Located in the heart of the Appalachian Mountains, only 4.8 square miles of the segment is utilized for farming, while 35.3 square miles are in forest and woodland and 0.4 square miles in mining.

Exhibit B-46.1t Basic Planning Data

Segment #46	Projection Years			
	1970	1975	1980	1995
Population Total	1,855	1,793	1,759	1,559
Rural	1,855	1,793	1,759	1,559
Farm	1,855	1,793	1,759	1,559
Non-Farm	-	-	-	-
Urban				
Housing Unit Total	503	521	551	600
Rural	503	521	551	600
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	4.8	4.8	4.8	4.8
Silviculture	35.3	35.3	35.3	35.3
Mining	0.4	0.4	0.4	0.4
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Due to the tremendous water volume contained in the reservoir, and the lack of any significant discharges into the lake, Segment #46 has been classified as Effluent Limited.

Segment Hydrology

Segment #46 lies in the Mountains and Eastern Coal Fields Physiographic Region and contains an area of 40.5 square miles. The upstream drainage area that feeds the segment encompasses 348.6 square miles. Buckhorn Lake has a surface area of 1,230 acres and a volume of 21,800 acre-feet.

Exhibit B-46.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
294	Buckhorn Lake State Park	Buckhorn Lake		E.A.	0.6	0.017	20.0	20.0	'.0	
295	Camping Area South	Gay's Creek		E.A.	0	0.005	25.0	25.0	4.0	
296	Camping Area North	Gay's Creek		E.A.	0	0.007	25.0	25.0	4.0	

Water Quality Data

Considerable water quality data exists in Storet Water Quality Data Files for waters within the reservoir. Eighteen stations were used within the reservoir area for collection of data. As expected, these records indicate poorer quality waters as sampling progresses from the surface to deeper levels of the reservoir. Dissolved oxygen levels decrease with depth, and mineral content such as iron and manganese increase. Phosphorus does not appear to be a problem in the reservoir waters.

Point Source Dischargers

There are no significant dischargers in the segment. All minor dischargers are shown on EXHIBIT B-46.2t.

Non-point Source Dischargers

Sedimentation of suspended solids carried by the Middle Fork into Buckhorn Reservoir is the only non-point source of pollution.

Waste Load Allocation and Priority

Due to the lack of any significant dischargers, a waste load allocation was not assigned. A segment priority of 16.8 was calculated using the following factors:

Population	1.8
Severity of Pollution	0.0
Non-point Sources	15.0
Segment Priority	16.8

Municipal Needs

There are no municipal needs for the segment.

Alternative Water Quality Management Plan

There are no alternative water quality management plans for the segment other than those related to Segment #45.

SEGMENT #47 ANALYSIS
435.6-254.8/300.1

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 120

Location

Segment #47 is located along the North Fork of the Kentucky River from its confluence with the Kentucky River (RM 254.8) to the Jackson municipal sewage treatment plant (RM 300.1). Portions of Breathitt, Lee, and Wolfe Counties lie within the segment.

Basic Planning Data

Segment #47 contains the Breathitt County rural non-farm community of Jackson, approximately 50% of the Lee County rural non-farm community of Beattyville and portions of rural Lee, Wolfe and Breathitt Counties. Jackson's population was 1,887 in 1970 and is expected to increase slightly to 1,970 by 1995. Beattyville's population was 461 in 1970 and is expected to remain stable through the planning period.

Principal manufacturing enployers in Jackson are the Royal Crown Bottling Company and the Jackson Stave Company, producer of barrel staves.

The rural population of the segment was estimated to be 5,570 in 1970 and is projected to increase slightly to 5,819 during the planning period.

Land use in the segment includes 51.9 square miles of agricultural land, 169.9 square miles of woodland and forest, and 0.5 square miles of mining activity.

Exhibit B-47.1t

Basic Planning Data

Segment #47	Projection Years 1970	1975	1980	1995
Population Total	6,031	6,032	6,101	6,280
Rural	6,031	6,032	6,101	6,280
Farm	5,570	5,571	5,640	5,819
Non-Farm	461	461	461	461
Urban	-	-	-	-
Housing Unit Total	1,717	1,818	1,969	2,415
Rural	1,717	1,818	1,969	2,415
Urban	-	-	-	-
Land Use (Sq. Mi.)	222.8	222.8	222.8	222.8
Rural	222.3	222.3	222.3	222.3
Agriculture	51.9	51.9	51.9	51.9
Silviculture	169.9	169.9	169.9	169.9
Mining	0.5	0.5	0.5	0.5
Construction	-	-	-	-
Urban	0.5	0.5	0.5	0.5

Classification

Due to an extremely high 7-day, 10-year low flow the segment has been classified as Effluent Limited.

Segment Hydrology

The segment is located in the Mountains and Eastern Coal Fields Physiographic Region. The drainage area of the segment is 217.84 square miles with 1,099.5 square miles of drainage above the segment. The stream slope of the main stem of the segment is 1.5 feet per mile. The area is mountainous and covered with second growth timber.

Water Quality Data

Water quality modeling data indicates a high quality water with a D.O. of 7.8 mg/1. Additional water quality data is needed and the Division of Water has proposed the installation of a secondary water quality monitoring station (#170) for the purpose of obtaining specific data. This station should be programmed for suspended solids, pH, and other water quality parameters associated with the extraction of coal. EXHIBIT B-3.6m indicates the location of the proposed monitoring station.

Point Source Dischargers

The only significant point source discharge is the municipal wastewater treatment plant serving the City of Jackson. All dischargers in the segment are listed on EXHIBIT B-47.2t and their location shown on EXHIBIT B-7m.

Exhibit B-47.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/1 Flow (mgd)	BOD	SS	NH3-N	Other
057	Jackson STP	Kentucky River		E.A.	28.0	0.28	35.0	35.0	1.5	
255	Jackson Elem. School	UT-Ky. River		E.A.	0	0.001	35.0	35.0	4.0	
256	Mt. Carmel High School	North Fork Kentucky River		E.A.	28.0	0.004	35.0	35.0	4.0	
257	District Office Building	(Jackson)-UT-N.Fk. Ky. River		E.A.	0	0.002	25.0	30.0	2.0	
258	Roadside Park	Jackson-North Fk. Ky. River		E.A.	20.0	0.003	20.0	20.0	2.0	
335	Rogers Elem. School	UT-Middle Fork of Lower Devil Creek		S.T.	0	0.003	50.0	50.0	12.0	
350	Tee Pee Rest	Miller's Br.-North Fork		E.A.	0	0.001	30.0	30.0	4.0	
351	Breathitt Funeral Home	Miller's Br.-North Fork		E.A.	0	0.001	30.0	30.0	4.0	

Exhibit B-47.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04057	Jackson STP	337.8	0.3	30/75.1	30/75.1	20/50.0	4.0	6-9 pH	159 Ca

Exhibit B-47.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Jackson)				
Treatment	-	-	-	-
I/I	.350	1.5	120	63
Collectors	.500	1.0	120	60
Interceptors	.150	2.0	120	36
Combined Sew.	-	-	-	-
Total Abatement Priority				159

Non-point Source Dischargers

A limited amount of mining occurs in this segment. The sediment load in the North Fork headwaters contributes to this problem.

Waste Load Allocation and Priority

A maximum daily T.O.D. load for the City of Jackson is 337.8 pounds per day and the segment priority has been calculated using the following factors:

Population	7.3
Severity of Pollution	97.7
Non-point Sources	15.0
Segment Priority	120.0

The construction abatement priority for the City of Jackson is shown on EXHIBIT B-47.4t.

Municipal Needs

The wastewater treatment facilities for the City of Jackson may be adequate to meet water quality standards if operated and maintained properly. Some outlying areas near the city should be sewered when possible. A 201 Facility Plan has been scheduled. This plan does and should include an investigation of inflow/infiltration into the collection system. An expansion of the existing facilities will be necessary in the near future.

Alternative Water Quality Management Plan

During 201 Facility Planning an evaluation should be made on a cost effective basis including additional unsewered areas and the incorporation of small dischargers into the municipal collection system.

Exhibit B-47.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04057	Jackson STP	T1A / T1A	394 lbs./day	T - 0 I/I- 0.07 C - 0.1 I - 0.03	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

In order to meet water quality standards, the municipal wastewater treatment plant must meet secondary standards of less than 30 mg/l of B.O.D., 30 mg/l of suspended solids, and 20 mg/l of NH3-N consistantly. Meager sampling data indicates that this has not been achieved in the past. Further sampling should be implemented to document this problem and if it is not corrected through proper operation and maintenance, consideration should be given to upgrading the plant to a higher or more effective treatment level in the 201 Facilities Plan.

SEGMENT #48 ANALYSIS
435.6-300.2/361.0

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 390

Location

Segment #48 consists of the North Fork of the Kentucky River from the Jackson sewage treatment plant (RM 300.2) to the Dam at the Hazard Water Plant (RM 361.8) and the related tributaries. Portions of the segment lie in Perry, Breathitt, and Knot Counties.

Basic Planning Data

Segment #48 contains 123.28 square miles of Perry County including the City of Hazard, 53.72 square miles of Breathitt County including the rural, non-farm community of Jackson, and 19.8 square miles of rural Knott County. The segment is mountainous in character, and contains numerous small, rural settlements and linear residential areas within the valleys. The population of the segment was estimated to be 16,278 in 1975. A slight decline in the segment population is expected to occur by 1995.

The City of Jackson, located in the soutnern sector of the segment, had a 1970 population of 5,459. Due to the scarcity of buildable land in the area, Hazard's population is expected to remain generally stable through the study period.

The principal manufacturing employers in Hazard include the East Kentucky Beverage Company, producers of soft drinks, and the Home Lumber Company, manufacturer of cabinets and ready-mixed concrete.

The rural area of Segment #48 includes an estimated 137.7 square miles of forest and woodland, 50.8 square miles of agricultural land, and 1.7 square miles of mining activity.

Exhibit B-48.1t Basic Planning Data

Segment #48	Projection Years			
	1970	1975	1980	1995
Population Total	16,654	16,278	16,251	15,251
Rural	9,308	8,926	8,753	7,822
Farm	9,308	8,926	8,753	7,822
Non-Farm	1,887	1,893	1,900	1,970
Urban	5,459	5,459	5,459	5,459
Housing Unit Total	4,571	4,763	5,070	5,865
Rural	3,059	3,148	3,332	3,766
Urban	1,512	1,615	1,738	2,099
Land Use (Sq. Mi.)	194.8	194.8	194.8	194.8
Rural	190.2	190.2	190.2	190.2
Agriculture	50.8	50.8	50.8	50.8
Silviculture	137.7	137.7	137.7	137.7
Mining	1.7	1.7	1.7	1.7
Construction	-	-	-	-
Urban	4.6	4.6	4.6	4.6

Classification

Due to the high 7-day, 10-year low flow characteristics of the North Fork of the Kentucky River and the low waste load discharged into the segment, it is classified as Effluent Limited.

Segment Hydrology

The North Fork of the Kentucky River has a 7-day, 10-year low flow of 27.9 cfs. Augmentation occurs as a result of Carr's Fork Reservoir located upstream. Physiographically, the segment is located in the Mountains and Eastern Coal Fields Region. There are numerous tributaries in this segment, including Grapevine Creek, Big Willard Creek, Big Creek, and Lotts Creek, giving the segment a total area of 193.6 square miles. The upstream drainage area emptying into the segment is 905.9 square miles. The average stream slope is 2.5 feet per mile.

Water Quality Data

During most periods of the year, the water quality is quite good, however, there is an indication from the limited information available that siltation and pH problems sometimes exist due to run off from strip mining activities. To further analyze this situation the strategies for water quality monitoring proposes two secondary stations in the segment. They are located at Jackson (#170) and at Hazard (#172).

Point Source Dischargers

The only significant point source in Segment #48 is the Hazard sewage treatment plant. A treatment level of T2A has been set as the minimum required treatment level in the present discharge location. At the present time, Hazard has a trickling filter plant that will not meet secondary effluent requirements. A list of all dischargers in Segment #48 are shown on EXHIBIT B-48.2t.

Non-point Source Dischargers

Significant non-point source discharges occur on the North Fork of the Kentucky River between Jackson and Hazard as the result of mineral extraction and associated activities in the form of sedimentation.

Waste Load Allocation and Priority

The waste load allocation for Hazard is set at 1,689 pounds of T.O.D. per day. The priority for the segment was determined using the following factors:

Population	14.4
Severity of Pollution	325.6
Non-point Sources	50.0
Segment Priority	390.0

The City of Hazard has been assigned a construction abatement priority which is shown on EXHIBIT B-48.4t.

Municipal Needs

Provided the removal of excessive inflow/infiltration is accompanied and quality operation of the plant is maintained, the present treatment will probably produce an effluent that will meet water quality standards. Removal of inflow/infiltration is necessary to prevent hydraulic overloading and poor plant performance.

Alternative Water Quality Management Plan

Should the 201 Facility Plan indicate that removal of the inflow/infiltration is not cost effective, the construction of an additional trickling filter with subsequent solids removal equipment may be necessary. Lagooning the effluent may be possible if land space is available.

Exhibit B-48.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
059	Hazard STP	North Fork Kentucky River		T.F.	28.0	1.1	40.0	45.0	18.0	
259	Combs MHP	Pad's Branch		E.A.	0	0.0025	40.0	40.0	10.0	
260	Chavies School	Grapevine Cr.		E.A.	0	0.010	35.0	35.0	4.0	
261	Willard Elem. School	Big Willard Creek		E.A.	0	0.015	40.0	40.0	4.0	
262	United Mine Workers Hosp.	UT-North Fork Kentucky River		E.A.	0	0.002	30.0	30.0	4.0	
263	Alice Combs Mem. Hospital	UT-North Fork Kentucky River		E.A.	0	0.001	30.0	30.0	4.0	
355	Stewart's Subdivision	First Cr. to N. Fk. Ky. River		E.A.	0	0.01	40.0	30.0	4.0	
264	L & N Railroad	North Fork Kentucky River		C.P.	0	0.004	30.0	15.0	12.0	
354	Stacy's Dairy Bar	Willard Cr. N. Fk. Ky. River		E.A.	0	0.0005	20.0	25.0	4.0	
265	Whitakers Restaurant	North Fork Kentucky River		E.A.	0	0.001	20.0	25.0	4.0	
332	Oak Branch Service Sta.	Lotts Creek		E.A.	0	0.002	20.0	20.0	4.0	
333	Comb Dairy Bar	Little Willard Creek		E.A.	0	0.005	30.0	30.0	4.0	
334	Dennis Wooten Elem. School	North Fork Kentucky River		E.A.	0	0.008	40.0	35.0	8.0	
370	Cordia School	Lotts Creek		ST & SF	0	0.004	40.0	35.0	8.0	

Exhibit B-48.3t -

Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04059	Hazard STP	1688.9	1.5	30/375.3	30/375.3	20/250.2	4.0	6-9 pH	585 Ca

Exhibit B-48.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Hazard)				
Treatment	-	-	-	-
I/I	1.0	1.5	390	510
Collectors	-	-	-	-
Interceptors	-	-	-	-
Combined Sew.	-	-	-	-
Total Abatement Priority				510

Exhibit B.48.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04059	Hazard	T2A T2A	1,092 lbs./day	T - 0 I/I- 0.25 C - 0 I - 0	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

SEGMENT #49 ANALYSIS
435.6-307.8-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 56.0

Location

Quicksand Creek is located in Knott and Breathitt Counties emptying into the North Fork of the Kentucky River at RM 307.8. Tributary streams of the segment include Leatherwood Creek, Press Howard Fork, Hunting Creek, Little Caney Creek, Hawes Fork, Sprung Fork, Middle Fork, Bradley Branch, Patter Fork, Laurel Fork, and Spicewood Branch.

Basic Planning Data

Segment #49 contains 199.65 square miles of rural Breathitt and Knott Counties. The segment is characterized by small rural settlements and linear residential development lining the valley roads. Population in the segment in 1970 was estimated to be 5,607 and is projected to increase to 6,398 by 1995.

Land use in the segment is estimated to be 21.3 square miles of agricultural land, 178 square miles of forest and woodland, and 0.3 square miles of mining activity.

Exhibit B-49.1t Basic Planning Data

Segment #49	Projection Years 1970	1975	1980	1995
Population Total	5,607	5,719	5,893	6,398
Rural	5,607	5,719	5,893	6,398
Farm	5,607	5,719	5,893	6,398
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	1,491	1,615	1,789	2,460
Rural	1,491	1,615	1,789	2,460
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	21.3	21.3	21.3	21.3
Silviculture	178.0	178.0	178.0	178.0
Mining	0.3	0.3	0.3	0.3
Construction	-	-	-	-
Urban	-	-	-	-

Exhibit B-49.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l Flow (mgd)	BOD	SS	NH3-N	Other
266	Rousseau Elem. School	Calhoun Branch		E.A.	0	0.003	40.0	35.0	8.0	
312	Dairy Bar & Drive-In Restaurant	Meeting House Branch		E.A.	0	0.0015	30.0	30.0	4.0	

Classification

Due to the lack of flow during a 7-day, 10-year low flow frequency, the segment has been classified as Water Quality Limited.

Segment Hydrology

Segment #49 lies within the Mountains and Eastern Coal Fields Physiographic Region. The area emcompassed within the segment is 199.65 square miles. The average stream slope of the main stem of Quicksand Creek is 5.6 feet per mile. Mining activity within the drainage basin will have an effect on segment hydrology.

Water Quality Data

Meager water quality data is available in U.S.G.S. Water Resources Data for Kentucky. That which is available indicates the water quality to be acceptable.

Point Source Dischargers

There are no significant point source dischargers in this segment.

Non-point Source Dischargers

Quicksand Creek carries a heavy silt load as a result of extensive strip mining operations within the watershed. South Fork of Quicksand Creek also is heavily loaded with silt from stripping operations in the headwater section of the stream. Sediment studies have been conducted by the U.S. Forest Service on Leatherwood Creek.

Waste Load Allocation and Priority

Since there are no significant waste loads in the segment, a waste load allocation was not assigned. The segment priority was calculated using the following factors:

Population	6.0
Severity of Pollution	0.0
Non-point Sources	50.0
Segment Priority	56.0

Municipal Needs

There are no municipal needs for this segment.

Alternative Water Quality Management Plan

There are no alternative water quality management plans for the segment.

SEGMENT #50 ANALYSIS
435.6-313.7-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 97

Location

Segment #50 includes Troublesome Creek and its tributaries. Troublesome Creek enters the Kentucky River at RM 313.7. The segment is located in portions of Knott, Breathitt and Perry Counties. EXHIBIT B-7m graphically locates the segment in the basin.

Basic Planning Data

Segment #50 contains the Knott County rural non-farm community of Hindman along with portions of rural Breathitt, Perry and Knott Counties.

Hindman's population in 1970 was 808 and projected to increase to 1,225 by 1995. Principal employer in Hindman is the Cornett Lumber Company, producers of rough lumber.

Population of the rural sector of the segment was estimated to 9,442 in 1970 and is projected to increase slightly to 9,486 by 1995.

Land use in the segment is estimated to be 49.6 square miles of agricultural land, 192.1 square miles of forest and woodland and 1.5 square miles of mining activity.

Exhibit B-50.1t — Basic Planning Data

Segment #50	Projection Years 1970	1975	1980	1995
Population Total	10,250	10,311	10,476	10,711
Rural	10,250	10,311	10,476	10,711
Farm	9,442	9,407	9,476	9,486
Non-Farm	808	904	1,000	1,225
Urban	-	-	-	-
Housing Unit Total	2,749	2,946	3,221	4,119
Rural	2,749	2,946	3,221	4,119
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	49.6	49.5	49.4	49.2
Silviculture	192.1	192.1	192.1	192.1
Mining	1.5	1.5	1.5	1.5
Construction	-	0.1	0.1	0.2
Urban	0.8	0.9	1.0	1.2

Classification

Due to the lack of an adequate 7-day, 10-year low flow to prevent water quality degradation by the discharge of the Hindman wastewater treatment plant, the segment has been classified as Water Quality Limited.

Segment Hydrology

Segment #50 is located in the Mountains and Eastern Coal Fields Physiographic Region. The area of the segment is 243.9 square miles. The average stream slope of Troublesome Creek is 9.3 feet per mile.

Exhibit B-50.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
058	Hindman STP	Troublesome Creek		E.A.	0	0.12	30.0	30.0	1.5	
267	Lost Creek Elem. School	Sixteen Mile Creek		E.A.	0	0.003	40.0	40.0	10.0	
268	Marie Roberts Elem. School	Lost Creek		E.A.	0	0.004	40.0	40.0	10.0	
269	Becham Combs Elem. School	John S. Combs Branch		E.A.	0	0.005	40.0	40.0	10.0	
270	Emmalena Elem. School	Troublesome Creek		E.A.	0	0.005	35.0	35.0	8.0	
271	Casey's IGA Food Mart & Apartments	Troublesome Creek		E.A.	0	0.015	30.0	30.0	4.0	
272	I.H. Buchanan Mining Co.	Lost Creek		L.	0	0.004	-	-	-	
273	Robinson Elem. School	Troublesome Creek		E.A.	0	0.008	35.0	35.0	8.0	
274	Hindman Elem. School	UT-Troublesome Creek		E.A.	0	0.001	35.0	35.0	4.0	
308	Carney Consol. School	Troublesome Creek		E.A.	0	0.003	30.0	30.0	4.0	
310	Borderline Inn Motel	Ten Mile Creek		E.A.	0	0.0025				
352	Clemon's Motel	Ten Mile Creek-Lost Creek-Troublesome Cr.		E.A.	0	0.0025	35.0	35.0	8.0	
353	E.Ky. Health Ser. Clinic	R. F. Troublesome Cr.		E.A.	0	0.001	35.0	35.0	4.0	

Exhibit B-50.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04058	Hindman STP	20.9	0.125	10/10.4	15/15.6	1.0/1.0	8.0	6-9 pH	288 Ca

Major tributaries are Sixteen Mile Creek, Lost Creek, John S. Combs Branch, Laurel Fork, Buckhorn Creek and Balls Fork.

Water Quality Data

The effluent of the Hindman wastewater plant enters Troublesome Creek at RM 42.4. For approximately 3 miles downstream using a 7-day, 10-year low flow frequency, water quality modeling data indicates that the D.O. will drop to 0.0 mg/1, the B.O.D. will approach 30 mg/1 and NH3-N will approach 20 mg/1.

Point Source Dischargers

One significant point source discharger exists in the segment in the form of the Hindman, Kentucky wastewater treatment plant discharge. All dischargers in the segment and their effluent characteristics are shown on EXHIBIT B-50.2t. Location of the significant discharger is shown graphically on EXHIBIT B-7m.

Non-point Source Dischargers

Silt from both inactive and active strip mining operations is a major water quality problem. Acid mine drainage has also been reported.

Waste Load Allocation and Priority

A maximum daily T.O.D. load of 21 pounds has been assigned to the City of Hindman.

The segment priority of 97 has been calculated using the following factors:

Population	10.3
Severity of Pollution	36.7
Non-point Sources	50.0
Segment Priority	97.0

The construction abatement priority for Segment #50 is computed in EXHIBIT B-50.4t.

Exhibit B-50.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Hindman)				
Treatment	.526	4.5	97	229.7
I/I	.053	1.5	97	7.7
Collectors	.316	1.0	97	30.6
Interceptors	.105	2.0	97	20.4
Combined Sew.	-	-	97	-
Total Abatement Priority				288

Municipal Needs

Municipal needs for the segment are shown on EXHIBIT B-50.5t. Based on water quality modeling, a treatment level of T4B will be required for the City of Hindman to prevent degradation of Troublesome Creek. Converting and expending the plant to extended aeration, addition of a sand filter and reduction of inflow/infiltration problems will probably meet the treatment requirements specified. Construction of collectors and inceptors will be necessary to serve an additional population of 300 people in the forseeable future. Additionally, a 201 Faciltiy Plan should be completed.

Exhibit B-50.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04058	Hindman STP	T4B / T4B	245 lbs./dat	T - 0.5 I/I- 0.05 C - 0.3 I - 0.1	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

During 201 Facility Planning, land application of the secondary effluent should be evaluated on a cost effective basis.

SEGMENT #51 ANALYSIS
435.6-254.8-45.1-0.0/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 231

Location

Segment #51 consists of the Goose Creek drainage basin which lies within Clay and Knox Counties. Goose Creek begins with its confluence with South Fork (RM 45.1) and the segment ends at the headwaters of Goose Creek.

Basic Planning Data

Segment #51 contains the Clay County rural non-farm community of Manchester and rural portions of Clay and Knox Counties.

Manchester's population was 1,664 in 1970 and is projected to increase to 2,048 by 1995. Principal manufacturers in Manchester include: Boone Boy Industries, Inc., producers of upholstered furniture, Clay County Furniture Manufacturer, makers of living roon furniture and the Etowah Manufacturing Company of Kentucky, fabricators of small electrical appliances and metal furniture.

The rural sector of Segment #51 is comprised of 51 square miles of agricultural land and 220.7 square miles of forest and woodland and 0.2 square miles of mining activity. The entire area of the segment is within the boundary of the Daniel Boone National Forest.

Exhibit B-51.1t

Basic Planning Data

Segment #51	Projection Years 1970	1975	1980	1995
Population Total	12,340	12,113	11,938	10,879
Rural	10,676	10,321	10,018	8,831
Farm	10,676	10,321	10,018	8,831
Non-Farm	1,664	1,792	1,920	2,048
Urban				
Housing Unit Total	3,289	3,416	3,607	3,950
Rural	3,289	3,416	3,607	3,950
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	51.0	50.9	50.9	50.8
Silviculture	220.7	220.7	220.7	220.7
Mining	0.2	0.2	0.2	0.2
Construction	-	0.1	-	0.1
Urban	0.7	0.8	0.8	0.9

Classification

Since the 7-day, 10-year low flow of Goose Creek is zero and since the waste load from both point and non-point sources is excessive, the segment has been classified as Water Quality Limited.

Segment Hydrology

Segment #51 is located in physiographic region known as Mountains and Eastern Coal Fields. Drainage area within the segment is 236.1 square miles. Slope of the main segment stream is 5.3 feet per mile. The land is mountainous, with rapid runoff of storm water. Mineral extraction is significant in the segment and affects water quality.

Water Quality Data

Water quality of Goose Creek is extremely poor reflecting the characteristics of the discharge of the Manchester wastewater treatment plant. According to water quality modeling data, which is based on a 7-day, 10-year low flow, a D.O. deficit in the stream exists for approximately 4 miles, NH3-N is approximately 15 mg/l and the B.O.D. is approximately 40 mg/l.

Point Source Dischargers

The Manchester municipal wastewater treatment plant is the only significant point source discharger in the segment. A listing of all dischargers and their discharge characteristics in the segment are shown on EXHIBIT B-51.2t and the significant discharger is located graphically on EXHIBIT B-8m.

Non-point Source Dischargers

Goose Creek is continuously being polluted by acid mine drainage from tributary streams including Island Creek, Little Goose Creek and Horse Creek. Siltation from strip mine operations also contribute to periodic siltation of streams in the segment.

Exhibit B-51.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l Flow (mgd)	BOD	SS	NH3-N	Other
065	Manchester STP	Goose Creek		T.F.		0.28	40.0	42.0	16.0	
283	Hacker Elem. School	Little Goose Creek		E.A.		0.004	40.0	40.0	8.0	
284	Repair & Main. Garage	Island Creek		E.A.		0.002	30.0	30.0	4.0	
285	Clay County Voc. School	Laurel Creek		E.A.		0.030	40.0	40.0	8.0	
286	Laurel Creek Elem. School	Laurel Creek		E.A.		0.006	40.0	40.0	8.0	
287	New Big Creek Mining Co.	Pen Paw Branch		Washer Eff S.P.		NA	-	45.0	-	
288	Shamrock Mining Company	Phillips Fork		S.P.		NA	-	45.0	-	
289	Roberts & Gregory Apts.	Horse Creek		E.A.		0.0075	40.0	40.0	8.0	

Exhibit B-51.3t. - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04065	Manchester STP	58.4	0.35	10/29.2	15/43.8	1.0/2.9	8.0	6-9 pH	668 Ca

Waste Load Allocation and Priority

The maximum daily waste load allocation of 58.4 pounds of T.O.D. per day has been assigned to the City of Manchester. A segment priority of 231.0 has been assigned based on the following factors:

Population	17.2
Severity of Pollution	168.3
Non-point Sources	50.0
Segment Priority	231.0

Construction abatement priority is shown on EXHIBIT B-51.4

Exhibit B-51.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Manchester)				
Treatment	.5	4.5	231	519.75
I/I	.143	1.5	231	49.5
Collectors	.286	1.0	231	66
Interceptors	.071	2.0	231	33
Combined Sew.	-	-	-	-
Total Abatement Priority				668

Municipal Needs

A 0.35 M.G.D. Trickling filter plant presently serves the City of Manchester. To prevent water quality standards violations in the future, the plant will need upgrading to a treatment level of T4B. The addition of a second trickling filter, lightly loaded followed by a filtration will probably be sufficient to prevent degradation of water quality. A 201 Facility Plan including the inflow/infiltration study should be computed. Collectors and inceptors will be needed for serving an additional 200 persons. Municipal needs costs are shown on EXHIBIT B-51.5t.

Exhibit B-51.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04065	Manchester STP	T4B T4B	333 lbs./day	T - 0.35 I/I- 0.1 C - 0.2 I - 0.05	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

During 201 Facility Planning, the alternative of land application of secondary effluent to stripped coal mine lands should be evaulated on a cost effective basis, thus eliminating the discharge in Goose Creek. Elimination of minor point sources discharges by inclusion on the comprehensive collection system of Manchester should also be considered during 201 Facilities Planning.

SEGMENT #52 ANALYSIS
435.6-254.8-41.1/

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 33.7

Location

Segment #52 is located in Leslie, Clay and Bell Counties and encompasses the drainage basin of the Redbird River from its confluence with the South Fork (RM 41.1) to its headwaters.

Basic Planning Data

Segment #52 contains rural portions of Clay, Leslie, and Bell Counties. The segment is characterized by numerous small rural settlements nestled in the valleys which traverse the rugged terrain. Population in the segment was estimated to be 6,575 in 1970 and is projected to decrease to 6,128 by 1995.

The segment contains an estimated 20.2 square miles of agricultural land, primarily in small holdings, 165.8 square miles of forest and woodland and 0.3 square miles of mining activity.

Exhibit B-52.1t Basic Planning Data

Segment #52	Projection Years			
	1970	1975	1980	1995
Population Total	6,575	6,510	6,485	6,128
Rural	6,575	6,510	6,485	6,128
Farm	6,575	6,510	6,485	6,128
Non-Farm	-1	-	-1	-
Urban				
Housing Unit Total	1,742	1,840	1,980	2,289
Rural	1,742	1,840	1,980	2,289
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	20.2	20.2	20.2	20.2
Silviculture	165.8	165.8	165.8	165.8
Mining	0.3	0.3	0.3	0.3
Construction	-	-	-	-
Urban	-	-	-	-

Exhibit B-52.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
290	Red Bird Mission Hosp.	UT-Red Bird	Ky. 0026000	E.A.	0	0.0075	40.0	40.0	8.0	
291	Big Creek Elem. School	Britton Branch		E.A.	0	0.0075	40.0	40.0	8.0	

Classification

Since there are no significant point source dischargers emptying into the segment, and the mining activity in the area has not severely affected water quality, the segment has been classified as Effluent Limited.

Segment Hydrology

Segment #52 lies within the Mountains and Eastern Coal Fields Physiographic Region and contains an area of 186.3 square miles. The average stream slope is 5.7 feet per mile and the 7-day, 10-year low flow is equal to zero. Major tributaries contained within the segment include; Big Creek, Sugar Creek, Elisha Creek, Flat Creek, Upper Jacks Creek and Redbird Creek.

Water Quality Data

Meager information available from U.S.G.S. Water Resources Data for Kentucky indicates that water quality of the segment is excellent.

Point Source Dischargers

There are no significant point source dischargers in the segment. If any are constructed, a T4B treatment level for any discharge point in the segment will be required. Likewise, small insignificant dischargers must also upgrade their treatment processes to a T4B level in order to maintain water quality in the segment. All dischargers and their effluent characteristics are shown on EXHIBIT B-52.2t.

Non-point Source Dischargers

The Redbird River is affected to a limited extent by silt from strip mine operations in the headwater sections periodically. There are some pH problems in the segment due to acid mine drainage but this is not frequent or severe.

Waste Load Allocation and Priority

Since there are no significant dischargers in the segment, waste load allocations were not assigned and the priority of the segment was computed using the following factors:

Population	8.7
Severity of Pollution	25.0
Non-point Sources	0.0
Segment Priority	33.7

Municipal Needs

Since there are no existing municipal wastewater treatment plants located within Segment #52, and none are planned in the immediate future, this section is not applicable to this segment.

Alternative Water Quality Management Plan

Strategies for water quality monitoring proposes the installation of a secondary station(#166) at approximately RM 15.0. This station is needed for collection of specific water quality parameters associated with mineral extraction.

SEGMENT #53 ANALYSIS
435.6-60.0/73.5

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 28.0

Location

Segment #53 begins at the tailwater of Buckhorn Lake (Middle Fork) (RM 60.0) to Rockhouse Creek (RM 73.5). Major tributaries in the segment are; Langdon Branch, Wilder Branch, Grassy Branch, Hell for Certain Creek, Bull Creek and Cutshin Creek. The segment lies in Leslie County.

Basic Planning Data

Segment #53 contains 113.59 square miles of rural Leslie County. The segment is characterized by a number of small, rural settlments and linear residential areas up and down the valleys and hollows. Population in the segment was estimated to be 3,104 in 1970 and is expected to increase slightly during the planning period.

Land use in the segment includes 13.7 square miles of agricultural land, 99.7 square miles of woodland and forest and 0.2 square miles of mining activity.

Exhibit B-53.1t

Basic Planning Data

Segment #53	Projection Years 1970	1975	1980	1995
Population Total	3,104	3,237	3,306	3,399
Rural	3,104	3,237	3,306	3,399
Farm	3,104	3,237	3,306	3,399
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	794	892	993	1,307
Rural	794	892	993	1,307
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	13.7	13.7	13.7	13.7
Silviculture	99.7	99.7	99.7	99.7
Mining	0.2	0.2	0.2	0.2
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Due to a 7-day, 10-year no flow frequency, the segment has been classified as Water Quality Limited.

Segment Hydrology

The physiographic region containing the segment is Mountains and Eastern Coal Fields Region. An area of 113.6 square miles is contained within the segment. The drainage area upstream of the segment contains 241.36 square miles. The average slope of the main stem of the segment is 2.9 feet per miles.

Water Quality Data

Meager data available indicates that water quality is satisfactory, however, additional data is needed. The water quality monitoring strategy proposes the establishment of one primary monitoring station (#56) at RM 76.1 and one secondary station (#169) at RM 62. These stations are necessary to adequately assess water quality.

Point Source Dischargers

There are no significant point source discharges in the segment. All minor discharges and their related wastewater characteristics are set forth on EXHIBIT B-53.2t.

Non-point Source Dischargers

Water quality of Cutshin Creek is being degraded by mining operations and this contribution has some effect in the form of non-point source pollution.

Waste Load Allocation and Priority

A waste load allocation was not assigned since there are no significant dischargers in the segment. The segment priority was determined using the following factors:

Population	3.0
Severity of Pollution	0.0
Non-point Sources	25.0
Segment Priority	28.0

Municipal Needs

There are no municipal needs in the segment.

Alternative Water Quality Management Plan

There are no alternative management plans proposed for this segment.

SEGMENT #54 ANALYSIS
435.6-258.6-73.5

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 113.9

Location

Segment #54 begins at the confluence of Rockhouse Creek and Middle Fork of the Kentucky River (RM 73.5) and extends upstream to include the headwaters of Rockhouse. Portions of Leslie and Harlan Counties lie in the segment. Major tributaries in the segment are Rockhouse Creek, Stinnett Creek, Lower Bad Creek, Upper Bad Creek, Greasy Creek, White Oak Creek, Beech Fork and Laurel Branch.

Basic Planning Data

Segment #54 contains the Leslie County non-farm community of Hyden along with rural portions of Leslie and Harlan Counties. Hyden's population in 1970 was 482 and is projected to increase to 1,082 by 1995. Population of the rural portions of the segment was estimated to be 9,286 in 1970 and is expected to decrease slightly to 9,239 by 1995.

The principal employer in Hyden is the Asher Coal and Lumber Company.

Land use in the segment was estimated to be 28.3 square miles of agricultural land, 212.8 square miles of forest and woodland and 0.5 square miles of mining activity.

Exhibit B-53.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l Flow (mgd)	BOD	SS	NH3-N	Other
305	Hayes Lewis School	Cutshin Creek		ST & SF	0	0.0007	40.0	40.0	8.0	

Exhibit B-54.1t

Basic Planning Data

Segment #54	Projection Years 1970	1975	1980	1995
Population Total	9,768	9,864	10,018	10,321
Rural	9,768	9,864	10,018	10,321
Farm	9,286	9,307	9,386	9,239
Non-Farm	482	557	632	1,082
Urban	-	-	-	-
Housing Unit Total	2,676	2,893	3,178	3,969
Rural	2,676	2,893	3,178	3,969
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	28.3	28.2	28.1	27.4
Silviculture	212.8	212.8	212.8	212.8
Mining	0.5	0.5	0.5	0.5
Construction	-	0.1	0.1	0.7
Urban	0.8	0.9	1.0	1.7

Classification

The segment has been classified as Water Quality Limited due to no flow conditions during a 7-day, 10 year frequency and the discharge of Hyden's waste-water treatment plant effluent.

Segment Hydrology

Segment #54 lies within the Mountains and Eastern Coal Fields Physiographic Region. The segment drainage area is 241.36 square miles. Slope of the main stem of the segment averages 23.5 feet per mile, a significant slope that accounts for a large reaeration fact factor.

Water Quality Data

Insufficient water quality data exists to properly assess water quality in this segment. Additional data should be secured by field personnel of the Division of Water, Department of Natural Resources and Environmental Protection.

Exhibit B-54.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l Flow (mgd)	BOD	SS	NH3-N	Other
062	Hyden STP	Middle Fork Kentucky River			0.2	0.080	45.0	50.0	10.0	
297	Kate Ireland (Resident)	Hurricane Creek		E.A.	0	0.007	30.0	30.0	4.0	
298	Leslie County High School	Middle Fork Kentucky River		E.A.	0.2	0.0075	40.0	40.0	8.0	
299	W. B. Muncey Elem. School	Davis Branch		E.A.	0	0.005	40.0	40.0	8.0	
300	Harlan County Forestry Camp	Laurel Creek		E.A.	0	0.005	40.0	40.0	10.0	
301	Leslie County Tele. Co. (Office Bldg.)	UT-Middle Fork		E.A.	0	0.001	40.0	40.0	8.0	
315	Byco Trailer Coach Park	Calvert Creek		E.A.	0	0.0025	40.0	40.0	10.0	
302	Leslie County Health Center	Calvert Creek		ST & SF	0	0.0007	23.0	10.0	10.0	
316	Stinnett Elem. School	Saltwell Branch		E.A.	0	0.0102	40.0	40.0	10.0	

Exhibit B-54.3t Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04062	Hyden STP	13.3	0.08	10/6.7	15/10.0	1.0/0.7	8.0	6-9 pH	60 Ca

Point Source Dischargers

The one significant point source discharger is the City of Hyden. Effluent characteristics of all dischargers are listed on EXHIBIT B-54.2t. Location of the significant dischargers are shown on EXHIBIT B-8m.

Non-point Source Dischargers

Mining activity is increasing within the segment boundary, thus increasing non-point source dischargers.

Waste Load Allocation and Priority

A maximum waste load allocation of 13.3 pounds per day of T.O.D. has been assigned to the City of Hyden, and is shown on EXHIBIT B-54.3t. The segment priority of 113.9 was calculated as follows:

Population	6.8
Severity of Pollution	72.1
Non-point Sources	35.0
Segment Priority	113.9

The construction abatement priority for the Hyden wastewater treatment plant is computed on EXHIBIT B-54.4t.

Exhibit B-54.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Hyden)				
Treatment	.280	4.5	28	35.35
I/I	.019	1.5	28	0.8
Collectors	.561	1.0	28	15.7
Interceptors	.140	2.0	28	7.85
Combined Sew.	-	-	-	-
Total Abatement Priority				60

Municipal Needs

The present municipal wastewater treatment plant has a capacity of 0.08 M.G.D. It will not provide sufficient treatment to prevent violation of stream standards. A T4B treatment level will be required. In addition, the treatment system and collection system needs expanding to serve an additional 600 persons. A 201 Facilities Plan is needed to determine the most cost effective method of accomplishing the above tasks and to evaluate inflow/infiltration problems. Costs associated with municipal needs are shown on EXHIBIT B-54.5t.

Exhibit B-54.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04062	Hyden STP	T1A / T1A	216 lbs./day	T - 0.3 I/I- 0.02 C - 0.6 I - 0.15	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

During 201 Facilities Planning, consideration should be given to the application of secondary effluent to land disposal and reduction of inflow/infiltration problems.

SEGMENT #55 ANALYSIS

435.6-361.0-388.0

CLASSIFICATION Effluent Limited
SEGMENT PRIROITY 60.3

Location

Segment #55 begins at the Hazard Water Plant (RM 361) on the North Fork of the Kentucky River and extends upstream to the confluence of the North Fork and Rockhouse Creek (RM 388.0). Portions of Letcher and Perry Counties are included in this segment.

Basic Planning Data

Segment #55 contains 192.36 square miles of rural Letcher and Perry Counties. Population in the segment in 1970 was estimated to be 5,178 and is expected to decrease to 3,950 by 1995.

Segment #55 contains an estimated 20.9 square miles of agricultural land, 169.4 square miles of forest and woodland, and 2.1 square miles of mining activity.

Exhibit B-55.1t Basic Planning Data

Segment #55	Projection Years			
	1970	1975	1980	1995
Population Total	11,563	11,040	10,640	8,779
Rural	11,563	11,040	10,640	8,779
Farm	11,563	11,040	10,640	8,779
Non-Farm	-	-	-	-
Urban				
Housing Unit Total	3,292	3,364	3,504	3,331
Rural	3,292	3,364	3,504	3,331
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	20.9	20.9	20.9	20.9
Silviculture	169.4	169.4	169.4	169.4
Mining	2.1	2.1	2.1	2.1
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Due to the lack of a significant waste load and a 7-day, 10-year low flow of approximately 28 cfs, the segment has been classified as Effluent Limited.

Segment Hydrology

The drainage area of the segment is 197.36 square miles and is located in the Mountains and Eastern Coal Fields Physiographic Region. An average stream slope of 5.2 feet per mile exists in the main segment stream. The drainage area above the segment is 186.9 square miles. Major tributaries include Little Leatherwood Creek, Line Fork, Defeated Creek, Clover Fork, Strattion Fork, Maces Creek, Bull Creek, Turkey Creek, Big Creek, and Ingram Creek.

Water Quality Data

Based on data obtained from U.S.G.S. Water Resources Data for Kentucky and water quality modeling conducted by the University, water quality within the segment is very good. Two secondary water quality monitoring stations have been proposed in the Division of Water's Strategies for Water Quality Monitoring. Station #175 to be located on Leatherwood Creek and the other station #176 to be located near Blackey on the North Fork of the Kentucky at approximately RM 384. Both stations should be programmed to monitor pH, conductivity, S.S. and other water quality parameters associated with mineral extraction.

Point Source Dischargers

There are no significant dischargers in the segment. All point sources and their discharge characteristics are shown on EXHIBIT B-55.2t.

Non-point Source Dischargers

The Leatherwood Creek watershed is experiencing considerable mining activities, the same condition is occuring on Line Fork. As a result of thse activities, a considerable silt load is being imposed on the segment.

Waste Load Allocation and Priority

Due to the lack of a significant waste load, a waste load allocation was not assigned.

A segment priority of 60.3 was calculated using the following factors:

Population	10.3
Severity of Pollution	0.0
Non-point Sources	50.0
Segment Priority	60.3

Municipal Needs

There are no municipal needs in this segment.

Alternative Water Quality Management Plan

There are no alternative water quality management plans for this segment.

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
276	Viper Elem. School	Left Fork Mason Creek		E.A.	0	0.005	35.0	40.0	10.0	
277	Chavies Elem. School	Eversole Creek		E.A.	0	0.004	35.0	40.0	10.0	
317	Blackey Elem. School	North Fork Kentucky River		E.A.	2.0	0.003	40.0	40.0	10.0	
318	Campbells Br. Elem. School	Line Fork Creek		E.A.	0	0.005	40.0	40.0	8.0	
319	Eolia Elem. School	Frank's Fork		E.A.	0	0.005	40.0	40.0	8.0	
320	Kingdom Come Elem. School	Line Fork		E.A.	0	0.003	40.0	40.0	8.0	
321	Leatherwood Elem. School	Clover Creek		E.A.	0	0.005	40.0	40.0	8.0	
357	Blue Diamond Coal Company	Clover Fork-Leatherwood Cr.		Pond	0	NA	-	45.0	-	6-9 pH
358	Echo Mining Co., Combs	North Fork Kentucky River		S.P.	2.0	NA	-	45.0	-	6-9 pH
360	Whittaker Mining Co.	Buffalo Cr.-N.F.Ky. River		S.P.	0	NA	-	45.0	-	6-9 pH
362	Standard Laboratories Building	Soloman Br.-N.F.Ky. River		E.A.	0	0.0005	25.0	25.0	4.0	
363	Martha Jone Porter Elem. School	North Fork Kentucky River		E.A.	2:0	0.001	40.0	40.0	8.0	
376	Aslo Coal Co.	N.F. Ky. River		Pond	2.0	NA	-	45.0	-	6-9 pH

SEGMENT #56 ANALYSIS
435.6-367.8-0.0/8.78

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 36.6

Location

Segment #56 begins on Carr Fork (RM 0.0) at its confluence with the North Fork of the Kentucky River, (RM 3,768). The upper boundary extends to the dam site on Carr Fork (RM 8.78). A portion of Perry and Letcher Counties is contained in the segment.

Basic Planning Data

Segment #56 contains the Perry County rural non-farm community of Vicco along with small portions of rural Perry and Letcher Counties.

Vicco's population in 1970 was 377 and is expected to remain stable during the planning period.

The segment contains an estimated 2.6 square miles of agricultural land and 18.4 square miles of forest and woodland.

Exhibit B-56.1t Basic Planning Data

Segment #56	Projection Years			
	1970	1975	1980	1995
Population Total	1,608	1,555	1,522	1,369
Rural				
Farm	1,231	1,178	1,145	992
Non-Farm	377	377	377	377
Urban	-	-	-	-
Housing Unit Total	442	456	481	526
Rural	442	456	481	526
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	2.6	2.6	2.6	2.6
Silviculture	18.4	18.4	18.4	18.4
Mining	0.2	0.2	0.2	0.2
Construction	-	-	-	-
Urban	1.0	1.0	1.0	1.0

Classification

Due to a 7-day, 10-year low flow of 28.7 cfs and the lack of a large waste load, the segment has been designated as Effluent Limited.

Segment Hydrology

The physiographic region commonly referred to as Mountains and Eastern Coal Fields comprises the segment area. Mountains and narrow valleys are common characteristics. Average slope of the main stem of the segment is 9.6 feet per mile.

Water Quality Data

Water quality of the segment will be influenced by the waters released from the Carr Fork Reservoir. Storet water quality data records indicate water quality within the reservoir as excellent with the possible exception of iron and manganese that is probably the result of decomposing vegetation within the new Reservoir. Release of upper level waters should be an asset to down stream users. Release of bottom waters of the reservoir could degrade the downstream waters and impose a water treatment problem for the City of Hazard. A secondary water quality monitoring station has been proposed for installation below the dam at Carr's Fork Reservoir at approximately Rm 8.3. Location of this proposed station is graphically shown on EXHIBIT B-8m.

Point Source Dischargers

One significant point source is included in the segment in the form of the effluent from the municipal wastewater treatment plant at Vicco. All dischargers and their wastewater characteristics within the segment are shown on EXHIBIT B-56.2t. The location of the discharger is shown graphically on EXHIBIT B-56.2t.

Non-point Source Dischargers

Tributaries to Carr's Fork, from the dam site to its mouth contribute heavy loads of acid mine drainage. Some sedimentation also occurs as the result of mineral extraction.

Exhibit B-56.2t Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/1				
						Flow (mgd)	BOD	SS	NH3-N	Other
060	Vicco STP	Carr Fork		E.A.	25.0	0.120	30.0	25.0	1.5	
356	Robert W.Combs Elem. School	Carr Fork		E.A.	25.0	0.008	40.0	40.0	12.0	
359	Kodak Mining Company	Old Carr Fork		S.P.	NA	-	-	-	-	6-9 pH
361	Evan's Drive Inn	Carr Fork		E.A.	25.0	0.0025	20.0	40.0	12.0	

Exhibit B-56.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04060	Vicco STP	168.9	0.150	30/37.5	30/37.5	20/25.0	4.0	6-9 pH	0 Ca

Waste Load Allocation and Priority

The daily maximum waste load allocation to the City of Vicco is set forth on EXHIBIT B-56.3t. A segment priority of 36.3 has been assigned based on the following factors:

Population	1.6
Severity of Pollution	35.0
Non-point Sources	0.0
Segment Priority	36.6

The construction abatement priority for Vicco has been computed and is shown on EXHIBIT B-56.4t.

Exhibit B-56.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Vicco)				
Treatment	-	-	-	-
I/I	-	-	-	-
Collectors	-	-	-	-
Interceptors	-	-	-	-
Combined Sew.	-	-	-	-
Total Abatement Priority				0

Municipal Needs

The existing treatment facilities should be adequate to meet water quality standards and for serving the community. No immediate needs are anticipated.

Exhibit B-56.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04060	Vicco STP	T1A / T1A	75.4 lbs./day	T - 0 I/I- 0 C - 0 I - 0	-

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Quality Management Plan

It is recommended that a cooperative management plan be developed between the U.S. Army Corps of Engineers and the Commonwealth of Kentucky relative to the release of waters from the reservoir to the extent that only high quality waters will be released during periods of low flow. This would be aimed at preventing degradation of segment waters. Consideration should also be given to changing the secondary monitoring station, located downstream from the Dam, to a primary monitoring station so that adequate water quality criteria may be obtained on a continuing basis.

SEGMENT #57 ANALYSIS
435.6-367.8-8.8/13.5

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 26.0

Location

Segment #57 begins at the Carr's Fork Dam (RM 8.8) and extends to the tailwaters (RM 16.35). Carr's Fork Reservoir is within the watershed of the segment and includes portions of Knott County.

Basic Planning Data

Segment #57 contains 25.84 square miles of rural Knott County. In 1970 the population of the segment was estimated to be 953 and is projected to increase slightly to 1,080 by 1995.

Land use in the segment is estimated to be 3.3 square miles of agricultural land, 22.4 square miles of forest and woodland and 0.1 square miles of mining activity.

Exhibit B-57.1t Basic Planning Data

Segment #57	Projection Years			
	1970	1975	1980	1995
Population Total	953	979	1,005	1,080
Rural	953	979	1,005	1,080
Farm	953	979	1,005	1,080
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	251	275	304	415
Rural	251	275	304	415
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	3.3	3.3	3.3	3.3
Silviculture	22.4	22.4	22.4	22.4
Mining	0.1	0.1	0.1	0.1
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Due to the large body of water and the absence of waste loads, the segment is classified as Effluent Limited.

Segment Hydrology

The segment is located in the Mountains and Eastern Coal Fields Physiographic Region. Area of the segment is 25.84 square miles. The hydraulic slope is 0.0 feet per mile. Tributaries within the segment include Irishman's Creek and Defeated Creek. The drainage area about this segment is 34.9 square miles.

Water Quality Data

Water quality data from Storet, U.S.G.S. water Resources Data for Kentucky and information developed by water quality modeling indicates a high quality water in the segment. Phosphorus does not appear to be a problem at the present time.

Point Source Dischargers

There are no significant point source dischargers in this segment. EXHIBIT B-57.2t lists all dischargers and their effluent characteristics.

Non-point Source Dischargers

Some strip mining activity and abandoned mining works contribute to degradation of waters on Defeated Creek and Irishman's Creek.

Waste Load Allocation and Priority

Due to the lack of waste loads, a waste load allocation was not assigned.

The segment priority was calculated using the following factors:

Population	1.0
Severity of Pollution	0.0
Non-point Sources	25.0
Segment Priority	26.0

Municipal Needs

There are no municipal needs in this segment.

Alternative Water Quality Management Plan

There are no water quality management plans. It should be pointed out however, that water quality management of the reservoir is an important aspect in the maintenance of downstream water quality. Therefore, a management agreement should be cooperatively developed by the U.S. Army Corps of Engineers and the Commonwealth of Kentucky for management control of the watershed and release of water from the Reservoir to downstream segments. Any further discharges to the lake should include phosphorus removal facilities before effluent release into the reservoir.

SEGMENT #58 ANALYSIS
435.6-367.8-13.5/

CLASSIFICATION Water Quality Limited
SEGMENT PRIORITY 36.3

Location

Segment #58 begins at the tailwaters of Carr's Fork Reservoir (RM 16.35) and extends to the headwaters. A portion of Knott County is located within the segment.

Basic Planning Data

Segment #58 contains 34.9 square miles of rural Knott County. The population of the segment was estimated to be 1,289 in 1970 and is projected to increase to 1,495 by 1995.

Of the 34.9 square miles in this segment, it is estimated that 4.4 square miles are in agricultural use, 30.3 in forest and woodland and .2 devoted to mining activity.

Exhibit B-58.1t — Basic Planning Data

Segment #58	Projection Years 1970	1975	1980	1995
Population Total	1,289	1,323	1,358	1,459
Rural	1,289	1,323	1,358	1,459
Farm	1,289	1,323	1,358	1,459
Non-Farm	-	-	-	-
Urban	-	-	-	-
Housing Unit Total	339	371	411	561
Rural	339	371	411	561
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	4.4	4.4	4.4	4.4
Silviculture	30.3	30.3	30.3	30.3
Mining	0.2	0.2	0.2	0.2
Construction	-	-	-	-
Urban	-	-	-	-

Classification

Carr's Fork does not flow on a 7-day, 10-year low flow frequency. Additionally, non-point sources contribute to degradation of the segment waters.

Segment Hydrology

Segment #58 is located in the Mountains and Eastern Coal Fields Physiographic Region. Major tributaries are Wolf Pen Creek and Smith Branch. Segment area is 34.9 square miles and the average stream slope of the main stem is 26.2 feet per mile.

Exhibit B-58.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-H	Other
368	Pioneer Coal Company	Yellow Creek-Carr Fork-N.F. Ky. River		E.A.		0.002	20.0	50.0	4.0	
309	Carr Creek Elem. School	Carr Creek		E.A.		0.004	35.0	35.0	8.0	

Water Quality Data

Water quality data is presently unavailable, however, Water Quality Monitoring Strategies proposed by the Division of Water, provided for the establishment of a secondary monitoring station (#174) at RM 16.4, for the purpose of monitoring water quality parameters related to mineral extraction. This station should provide the additional data needed for control purposes. Location of this station is shown on EXHIBIT B-8m.

Point Source Dischargers

There are no significant point source discharges in the segment. All dischargers and their discharge characteristics are shown on EXHIBIT B-58.2t.

Non-point Source Dischargers

Heavy silt loads are being contributed to the segment due to mineral extraction activities. The total effect of these activities on water quality is not well documented. Additional data is needed.

Waste Load Allocation and Priority

A waste load allocation was not assigned due to the lack of significant dischargers.

The segment priority was calculated using the following factors:

Population	1.3
Severity of Pollution	0.0
Non-point Sources	35.0
Segment Priority	36.3

Municipal Needs

There are no municipal needs in the segment within the time frame of this plan.

Alternative Water Quality Management Plan

An alternative water quality management plan is not applicable to this segment, other than more strictly controlling mining activities within the segment boundaries to prevent sedimentation of Carr Fork Reservoir.

SEGMENT #59 ANALYSIS
435.6-338.0/

CLASSIFICATION Effluent Limited
SEGMENT PRIORITY 62.6

Location

Segment #59 begins at the confluence point of the North Fork of the Kentucky River, (RM 388.0) and extends up the North Fork to its headwaters. Portions of Letcher County are included in this segment.

Basic Planning Data

Segment #59 is contained within the boundaries of Letcher County and includes the rural non-farm comcumities of Whitesburg, Neon, Flemming, and McRoberts. The segment is characterized as mountainous, with numerous rural settlements scattered throughout, and linear residential areas radiating from the four principal non-farm communities and the larger rural settlements. The population of the segment was estimated to be 14,101 in 1975 and a decline to 11,822 is projected for the study period.

Whitesburg is the largest of the non-farm communities within the segment, with an estimated 1975 population of 1,137. Total non-farm population in the segment for 1975 was estimated to be 3,352. No significant change in rural non-farm population is projected for the study period.

Principal employers in Whitesburg include Coca Cola Bottling Works, Royal Crown Bottling Company, and Greene and Webb Lumber Company.

The rural area of the segment includes 163.8 square miles of forest and woodland, 16.9 square miles of agricultural land, and 1.6 square miles of mining activity. The Pine Mountain Wildlife Area lies along the southwest margin of the segment.

Exhibit B-59.1t

Basic Planning Data

Segment #59	Projection Years 1970	1975	1980	1995
Population Total	14,555	14,101	13,665	11,822
Rural	14,555	14,101	13,665	11,822
Farm	11,203	10,749	10,313	8,470
Non-Farm	3,352	3,352	3,352	3,352
Urban	-	-	-	-
Housing Unit Total	4,281	4,448	4,680	4,411
Rural	4,281	4,448	4,680	4,411
Urban	-	-	-	-
Land Use (Sq. Mi.)				
Rural				
Agriculture	16.9	16.9	16.9	16.9
Silviculture	163.8	163.8	163.8	163.8
Mining	1.6	1.6	1.6	1.6
Construction	-	-	-	-
Urban	4.5	4.5	4.5	4.5

Classification

Due to a sustained low flow of 2.0 cfs during a 7-day 10-year low flow frequency and the absence of a large waste load, the segment has been classified as Effluent Limited.

Segment Hydrology

Segment #59 is located in the Mountains and Coal Fields Physiographic Region. Area of the segment is 186.87 square miles and contains the headwaters of the North Fork of the Kentucky River. Average slope of the main stem segment is 10.1 feet per mile. Land within the segment is mountainous, covered with second growth timber and contains considerable mineral extraction in the form of coal.

Water Quality Data

U.S.G.S. Water Resources Data for Kentucky indicates that one chemical analysis was conducted in 1971 and one in 1972 at Whitesburg. Results were as follows in mg/l except as noted.

	Total Phosphorus	Dissolved Solids	pH (Units)
OCT 1971	0.03	442	81
AUG 1972	0.15	524	82

Point Source Dischargers

One significant point source discharge, the City of Whitesburg, exists in the segment. All dischargers are listed on EXHIBIT B-59.2t, and are graphically located on EXHIBIT B-8m.

Non-point Source Dischargers

The segment includes Rockhouse Creek and the headwaters of the North Fork, both of which receive heavy loads of silt from the extraction of minerals. The upper section of Rockhouse Creek is periodically polluted with acid and mine drainage. This pollution is sufficiently diluted in the lower section of the stream to support a low fish population. Kings Creek a small tributary of the North Fork at Roxana, is affected by strip mining in the watershed. The North Fork in Letcher County is also being affected by strip mining in the watershed.

Waste Load Allocation and Priority

The maximum daily T.O.D. load for the City of Whitesburg has been calculated to be 563 pounds per day. The segment priority was determined by using the following factors:

Population	12.6
Severity of Pollution	0.0
Non-point Sources	50.0
Segment Priority	62.6

Construction abatement priority for the City of Whitesburg is set forth on EXHIBIT B-59.4t.

Exhibit B-59.2t

Existing Discharge Characteristics

Code No.	Facility	Location	NPDES Permit #	Type of Treatment	Q7-10 (cfs)	Discharge Characteristics mg/l				
						Flow (mgd)	BOD	SS	NH3-N	Other
061	Whitesburg STP	North Fork Kentucky River		E.A.		0.375	30.0	30.0	1.5	
322	Colson Elem. School	Rockhouse Creek		E.A.		0.0075	40.0	40.0	8.0	
323	Cowan Elem. School	Cowan Creek		E.A.		0.004	40.0	40.0	8.0	
324	Fleming-Neon High School	Yonts Fork		S.T.		0.004	40.0	40.0	8.0	
325	Letcher Consol. School	Rockhouse		E.A.		0.0075	40.0	40.0	8.0	
326	McRoberts Elem. School	Shea Fork		E.A.		0.004	40.0	40.0	8.0	
327	Hemphill Elem. School	Yonts Fork		E.A.		0.004	40.0	40.0	8.0	
366	Elkhorn Jellico Coal Co.	Camp Branch-Rockhouse Cr.		S.P.		NA	0.0	45.0	-	6-9 pH
328	Beth-Elkhorn Corp. Mine #22	Rockhouse Creek		E.A.		40.0	-	40.0	-	6-9 pH
364	Kentucky W.Va. Armature Plant	North Fork Kentucky River		E.A.		0.001	20.0	20.0	4.0	
329	Church of Christ	Yonts Fork		E.A.		0.0004	30.0	30.0	8.0	
365	Polly Mine	Camp Branch, Rockhouse Cr.		E.A.		0.0025	20.0	45.0	8.0	
330	Ashland Oil Service Sta.	North Fork Kentucky River		E.A.		0.001	25.0	25.0	4.0	
367	Johnson Elkhorn Coal Company	Rockhouse Cr.-N.F. Ky. River		S.P.		NA	-	45.0	-	6-9 pH
331	Adams Store (Jenkins)	North Fork Kentucky River		Sed.		-	30.0	60.0	18.0	

Exhibit B-59.3t - Waste Load Allocations (1980)

Code Number	Facility	Maximum Daily TOD Load lbs./day	Proposed Effluent Characteristics (mg/l / lbs./day)						Priority
			Flow (mgd)	BOD	SS	NH3-N	DO (mg/l)	Other	
04061	Whitesburg STP	563	0.5	30/125	30/125	20/83.4	4.0	6-9 pH	81 Ca

Exhibit B-59.4t Construction Abatement Priority

(Discharger) Needs	% of Total Needs	Multiplication Factor	Segment Priority	Sub Total
(Letcher Co.)				
Treatment	.090	2.0	62.6	11.3
I/I	.008	1.5	62.6	0.7
Collectors	.709	1.0	62.6	44.4
Interceptors	.193	2.0	62.6	24.2
Combined Sew.	-	-	-	-
Total Abatement Priority				81

Municipal Needs

The present treatment plant is a 0.5 M.G.D. contact stabilization plant. It has been proposed that the Whitesburg wastewater system serve as a regional system to serve an additional 6,000 persons located in Neon, Fleming Sergent, Millstone, Kona, Seco, McRoberts, May King and Ermire. Inflow/infiltration problems exist. To serve the additional population, the plant needs expanding to 1.0 M.G.D. A 201 Facilities Plan should be completed to determine the feasibility, on a cost effective basis, of serving the communities mentioned above and removal of the excessive inflow/infiltration. To serve the population mentioned, additional trunk lines and collectors will also be needed. Costs for completion of the work set forth above are shown on EXHIBIT B-59.5t.

Exhibit B-59.5t Municipal Needs

Code No.	Facility	Treatment Needs 1980/1995	1995 Disposal Needs	Cost * Million $	Comp. Goals
04061	Whitesburg STP	T1A / T1A	1,400 lbs./day	T - 0.7 I/I- 0.06 C - 5.5 I - 1.5	1977

* T = Treatment, I/I = Inflow/Infiltration, C = Collection, I = Interceptors, CS = Combined Sewer Separation

Alternative Water Qualtiy Management Plan

During the process of 201 Facility Planning, alternatives to construction of the expensive trunk line to the upstream communities may exist in the removal of the water supply point for the City of Whitesburg and construction of a separate wastewater plant to serve the upstream communities. Removal of the water supply point to a reservoir would permit the discharge of wastewater above Whitesburg. Land application of secondary wastewater treatment plant effluent for the small communities may also be considered, thus negating the need for removal of the raw water supply intake.

DEFINITION OF TERMS

abatement: The method of reducing the degree or intensity of pollution, also the use of such a method.

activated carbon: A highly adsorbent form of carbon, used to remove odors and toxic substances from gaseous emissions. In advanced waste treatment, activated carbon is used to remove dissolved organic matter from waste water.

activated sludge: Sludge that has been aerated and subjected to bacterial action, used to remove organic matter from sewage.

activated sludge process: The process of using biologically active sewage sludge to hasten breakdown of organic matter in raw sewage during secondary waste treatment.

advanced waste treatment: Waste water treatment beyond the secondary or biological state that includes removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids. Advanced waste treatment known as tertiary treatment, is the "polishing stage" of waste water treatment and produces a high quality effluent.

aeration: The process of being supplied or impregnated with air. Aeration is used in waste water treatment to foster biological and chemical purification.

aerobic: This refers to life or processes that can occur only in the presence of oxygen.

agricultural pollution: The liquid and soild wastes from all types of farming, including runoff from pesticides, fertilizers and feedlots; erosion and and dust from plowing, animal manure and carcasses and crop residues and debris. It has been estimated that agricultural pollution in the U.S. has amounted to more than 2 1/2 billion tons per year.

algal bloom: A proliferation of living algae on the surface of lakes, streams or ponds. Algal blooms are stimulated by phosphate enrichment.

ambient air: Any unconfined portion of the atmosphere; the outside air.

anaerobic: Refers to life or processes that occur in the absence of oxygen.

aquatic plants: Plants that grow in water either floating on the surface, growing up from the bottom of the body of water or growing under the surface of the water.

assimilation: Conversion or incorporation of absorbed nutrients into protoplasm. Also refers to the ability of a body of water to purify itself of organic pollution.

bacteria: Single-celled microorganisms that lack cholorphyll. Some bacteria are capable of causing human, animal or plant diseases, others are essential in pollution control because they break down organic matter in the air and in the water.

bar screen: In waste water treatment, a screen that removes large floating and suspended solids.

biochemical oxygen demand (B.O.D.): A measure of the amount of oxygen consumed in the biological processes that break down organic matter in the water. Large amounts of organic waste use up large amounts of dissolved oxygen, thus the greater the degree of pollution, the greater the B.O.D.

biodegradable: The process of decomposing quickly as a result of the action of microorganisms.

biological control: A method of controlling pests by means of introduced or naturally occurring predatory organisms, sterilization or the use of inhibiting hormones, etc., rather than by a mechanical or chemical means.

biological oxidation: The process by which bacterial and other microorganisms feed on complex organic materials and decompose them. Self-purification of waterways and activated sludge and trickling filter waste water treatment processes depend on this principle. The process is also called biochemical oxidation.

biota: All the species of plants and animals occurring within a certain area.

BOD: See biochemical oxygen demand.

BOD5: The amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter in an effluent. See biochemical oxygen demand.

carbon dioxide (CO_2): A colorless, ordorless, nonpoisonous gas that is a normal part of the ambient air. CO_2 is a product of fossil fuel combustion, and some researchers have theorized that excess CO_2 raises atmospheric temperatures.

cfs: Cubic feet per second, a measure of the amount of water passing a given point.

chemical oxygen demand (C.O.D.): A measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water. The COD test, like the BOD test, is used to deter mine the degree of pollution in an effluent.

chlorinator: A device for adding a chlorine-containing gas or liquid to drinking or waste water.

chlorine-contact chamber: In a waste treatment plant, a chamber in which effluent is disinfected by chlorine before it is discharged to the receiving waters.

chlarification: In waste water treatment, the removal of turbidity and suspended solids by settling, often aided by centrifugal action and chemically induced coagulation.

clarifier: In waste water treatment, a settling tank which mechanically removes settleable solids from wastes.

coagulation: The clumping of particles in order to settle out impurities; often induced by chemicals such as lime or alum.

COD: See chemical oxygen demand.

coliform index: An index of the purity of water based on a count of its coliform bacteria.

coliform organism: Any of a number of organisms common to the intestinal tract of man and animals whose presence in waste water is an indicator of pollution and of potentially dangerous bacterial contamination.

combined sewers: A sewerage system that carries both sanitary sewage and storm water runoff. During dry weather, combined sewers carry all waste water to the treatment plant. During a storm, only part of the flow is intercepted because of plant overloading; the remainder goes untreated to the receiving stream.

comminutor: A device that grinds solids to make them easier to treat.

composting: A controlled process of degrading organic matter by microorganisms. (1) mechanical--a method in which the compost is continuously and mechanically mixed and aerated. (2) ventilated cell--compost is mixed and aerated by being dropped through a vertical series of ventilated cells. (3) windrow--an open-air method in which compostable material is placed in windrows, piles or ventilated bins or pits and occasionally turned or mixed. The process may be anaerobic or aerobic.

decomposition: Reduction of the net energy level and change in chemical composition of organic matter because of the actions of aerobic or anaerobic microorganisms.

diffused air: A type of sewage aeration. Air is pumped into the sewage through a perforated pipe.

digester: In a waste water treatment plant, a closed tank that decreases the volume of solids and stabilizes raw sludge by bacterial action.

digestion: The biochemical decomposition of organic matter. Digestion of sewage sludge takes place in tanks where the sludge decomposes, resulting in partial gasification, liquefaction and mineralization of pollutants.

disinfection: Effective killing by chemical or physical processes of all organisms capable of causing infectious disease. Chlorination is the disinfection method commonly employed in sewage treatment processes.

dissolved oxygen (DO): The oxygen dissolved in water or sewage. Adequately dissolved oxygen is necessary for the life of fish and other aquatic organisms and for the prevention of offensive odors. Low dissolved oxygen concentrations generally are due to discharge of excessive organic solids having high BOD, the result of inadequate waste treatment.

dissolved solids: The total amount of dissolved material, organic and inorganic, contained in water or wastes. Excessive dissolved solids make water unpalatable for drinking and unsuitable for industrial uses.

effluent: A discharge of pollutants into the environment, partially or completely treated or in its natural state. Generally used in regard to discharges into waters.

environment: The sum of all external conditions and influences affecting the life, development and, ultimately, the survival of an organism.

erosion: The wearing away of the land surface by wind or water. Erosion occurs naturally from weather or runoff, but is often intensified by man's land-clearing practices.

eutrophication: The normally slow aging process by which a lake evolves into a bog or marsh and ultimately assumes a completely terrestrial state and disappears. During eutrophication the lake becomes so rich in nutritive compounds, especially nitrogen and phosphorus, that algae and other microscopic plant life become superabundant, thereby "choking" the lake, and causing it eventually to dry up. Eutrophication may be accelerated by many human activities.

fecal coliform bacteria: A group of organisms common to the intestinal tracts of man and of animals. The presence of fecal coliform bacteria in water is an indicator of pollution and of potentially dangerous bacterial contamination.

filtration: In waste water treatment, the mechanical process that removes particulate matter by separating water from solid material usually by passing it through sand.

flocculation: In waste water treatment, the process of separating suspended solids by chemical creating of clumps of flocs.

flowmeter: In waste water treatment, a meter that indicates the rate at which waste water flows through the plant.

flume: A channel, either natural or man-made, which carries water.

groundwater: The supply of freshwater under the earth's surface in an aquifer or soil that forms the natural reservoir for man's use.

groundwater runoff: Groundwater that is discharged into a stream channel as spring or seepage water.

habitat: The sum total of environmental conditions of a specific place that is occupied by an organism, a population or a community.

hard water: Water containing dissolved minerals such as calcium, iron and magnesium. The most notable characteristic of hard water is its inability to lather soap. Some pesticide chemicals will curdle or settle out when added to hard water.

humus: Decomposed organic material.

hydrogen sulfide (H_2S): A malodorous gas made up of hydrogen and sulfur with the characteristic ordor of rotten eggs. It is emitted in the natural decomposition of organic matter and is also the natural accompaniment of advanced stages of eutrophication. H_2S is also a by-product of refinery activity and the combustion of oil during power plant operations. In heavy concentrations, it can cause illness.

hydrology: The science dealing with the properties, distribution and circulation of water and snow.

impoundment: A body of water, such as a pond, confined by a dam, dike, floodgate or other barrier.

incineration: The controlled process by which solid, liquid, or gaseous combustible wastes are burned and changed into gases; the residue produced contains little or no combustible material.

infiltration: The flow of a fluid into a substance through pores or small openings. Commonly used in hydrology to denote the flow of water into soil material.

interceptor sewers: Sewers used to collect the flows from main and trunk sewers and carry them to a central point for treatment and discharge. In a combined sewer system, where street runoff from rains is allowed to enter the system along with sewage, interceptor sewers allow some of the sewage to flow untreated directly into the receiving stream to prevent the plant from being overloaded.

lagoon: In waste water treatment, a shallow pond usually man-made where sunlight, bacterial action and oxygen interact to restore waste water to a reasonable state of purity.

lateral sewers: Pipes running underneath city streets that collect sewage from homes of businesses.

leachate: Liquid that has percolated through solid waste or other mediums and has extracted dissolved or suspended materials from it.

methane: Colorless, nonpoisonous and flammable gaseous hydrocarbon. Methane, (CA_4), is emitted by marshes and by dumps undergoing anaerobic decomposition.

MGD: Millions of gallons per day. Mgd is commonly used to express the rate of flow.

monitoring: Periodic or continuous determination of the amount of pollutants or radioactive contamination present in the environment.

nutrients: Elements or compounds essential as raw materials for organism growth and development; for example, carbon, oxygen, nitrogen and phosphorus.

oil spill: The accidental discharge of oil into oceans, bays or inland waterways. Methods of oil spill control include chemcial dispersion, combustion, mechanical containment and absorption.

organic: Referring to or derived from living organisms. In chemistry, any compound containing carbon.

outfall: The mouth of a sewer, drain or conduit where an effluent is discharged into the receiving waters.

oxidation: A chemical reaction in which oxygen unites or combines with other elements. Organic matter is oxidized by the action of aerobic bacteria; thus oxidation is used in waste water treatment to break down organic wastes.

package plant: A prefabricated or pre-built waste water treatment plant.

particulates: Finely divided solid or liquid particles in the air or in an emission. Particulates include dust, smoke, fumes, mist, spray and fog.

percolation: Downward flow or infiltration of water through the pores or spaces of a rock or soil.

pH: A measure of the acidity or alkalinity of a material, liquid or solid. pH is represented on a scale of 0 to 14 with 7 representing a neutral state, 0 representing the most acid and 14, the most alkaline.

phosphorus: An element that while essential to life, contributes to the eutrophication of lakes and other bodies of water.

point source: In air pollution, a stationary source of a large individual emission, generally of an industrial nature. This is a general definition point source is legally and precisely defined in

Federal regulations.

pollutant: Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose.

pollution: The presence of matter or energy whose nature, location or quantity produces undesired environmental effects.

potable water: Water suitable for drinking or cooking purposes from both health and aesthetic considerations.

ppm: Parts per million. The unit commonly used to represent the degree of pollutant concentration where the concentrations are small. Larger concentrations are given in percentages. Thus BOD is represented in ppm while suspended solids in water are expressed in percentages. In air, ppm is usually a volume/volume ratio; in water, a weight/volume ratio.

precipitate: A solid that separates from a solution because of some chemical or physical change or the formation of such a solid.

pretreatment: In waste water treatment, any process used to reduce pollution load before the waste water is introduced into a main sewer system or delivered to a treatment plant for substantial reduction of the pollution load.

primary treatment: The first stage in waste water treatment in which substantially all floating or settleable solids are mechanically removed by screening and sedimentation.

pumping station: A station at which sewage is pumped to a higher level. In most sewer systems pumping is unnecessary; waste water flows by gravity to the treatment plant.

putrescible: Capable of being decomposed by microorganisms with sufficient rapidity to cause nuisances from odors, gases, etc. For example, kitchen wastes or dead animals.

raw sewage: Untreated domestic or commercial waste water.

receiving waters: Rivers, lakes, oceans, or other bodies that receive treated or untreated waste waters.

reservoir: A pond, lake, tank or basin, natural or man-made, used for the storage, regulation and control of water.

river basin: The total area drained by a river and its tributaries.

runoff: The portion of rainfall, melted snow or irrigation water that flows across ground surface and eventually is returned to streams. Runoff can pick up pollutants from the air or the land and carry them to the receiving waters.

sanitary landfill: A site for solid waste disposal using sanitary landfilling techniques.

sanitary sewers: Sewers that carry only domestic or commercial sewage. Storm water runoff is carried in a separate system.

screening: The removal of relatively coarse floating and suspended solids by straining through racks or screens.

secondary treatment: Waste water treatment, beyond the primary stage, in which bacteria consume the organic parts of the wastes. This biochemical action is accomplished by use of trickling filters or the activated sludge process. Effective secondary treatment removes virtually all floating and settleable solids and approximately 90% of both BOD and suspended solids. Customarily, disinfection by chlorination is the final stage of the secondary treatment process.

sedimentation: In waste water treatment, the settling out of solids by gravity.

sedimentation tanks: In waste water treatment, tanks where the solids are allowed to settle or to float as scum. Scum is skimmed off; settled solids are pumped to incinerators, digesters, filters or other means of disposal.

septic tank: An underground tank used for the deposition of domestic wastes. Bacteria in the wastes decompose the organic matter, and the sludge settles to the bottom. The effluent flows through drains into the ground. Sludge is pumped out at regular intervals.

settleable solids: Bits of debris and fine matter heavy enough to settle out of waste water.

settling chamber: In air pollution control, a low-cost device used to reduce the velocity of flue gases usually by means of baffle, promoting the settling of fly ash.

sewage: The total of organic waste and waste water generated by residential and commercial establishments.

sewer: Any pipe or conduit used to collect and carry away sewage or storm water runoff from the generating source to treatment plants or receiving streams. A sewer that conveys household and commercial sewage is called a sanitary sewer. If it transports runoff from rain or snow, it is called a storm sewer. Often storm water runoff and sewage are transported in the same system or combined sewers.

silt: Finely divided particles of soil or rock. Often carried in cloudy suspension in water and eventually deposited as sediment.

skimming: The mechanical removal of oil or scum from the surface of water.

sludge: The construction of solids removed from sewage during waste water treatment. Sludge disposal is then handled by incineration, dumping or burial.

solid waste: Useless, unwanted or discarded material with insufficient liquid content to be free flowing. (1) agricultural--solid waste that results from the raising and slaughtering of animals, and the processing of animal products

and orchard and field crops. (2) commercial--waste generated by stores, offices and other activities that do not actually turn out a product. (3) industrial--waste that results from industrial processes and manufacturing. (4) institutional--waste originating from educational, health care and research facilities. (5) municipal--residential and commercial solid waste generated within a community. (6) presticde--the residue from the manufacturing, handling, or use of chemicals intended for killing plant and animal pests. (7) residential--waste that normally originates in a residential environment. Sometimes called domestic solid waste.

solid waste disposal: The ultimate disposition of refuse that cannot be salvaged or recycled.

solid waste management: The purposeful, systematic control of the generation, storage, collection, transport, separation, processing, recycling, recovery and disposal of solid wastes.

storm sewer: A conduit that collects and transports rain and snow runoff back to the ground water. In a separate sewage system, storm sewers are entirely separage from those carrying domestic and commercial waste water.

strip mining: A process in which rock and top soil strata overlying ore or fuel deposits are scraped away by mechanical shovels. Also known as surface mining.

surveillance system: A monitoring system to determine environmental quality. Surveillance systems should be established to monitor all aspects of progress toward attainment of environmental standards and to identify potential episodes of high pollutant concentrations in time to take preventive action.

suspended solids: Small particles of solid pollutants in sewage that contribute to turbidity and that resist separation by conventional means. The examination of suspended solids and the BOD test consitute the two main determinations for water quality performed at waste water treatment facilities.

tertiary treatment: Waste water treatment beyond the secondary, or biological stage that includes removal of nutrients such as phosphorus and nitrogen, and a high percentage of suspended solids. Tertiary treatment, also known as advanced waste treatment, produces a high quality effluent.

thermal pollution: Degradation of water quality by the introudction of a heated effluent. Primarily a result of the discharge of cooling waters from industrial processes, particularly from electrical power generation. Even small deviations from normal water temperatures can affect aquatic life. Thermal pollution usually can be controlled by cooling towers.

topography: The configuration of a surface area including its relief, or relative elevations, and the position of its natural and man-made features.

toxicity: The quality of degree of being poisonous or harmful to plant or animal life.

trickling filter: A device for the biological or secondary treatment of waste water consisting of a bed of rocks or stones that support bacterial growth. Sewage is trickled over the bed enabling the bacteria to break down organic wastes.

turbidity: A thick, hazy condition in water due to the suspension of silt or finely divided organic matter.

urban runoff: Storm water from city streets and gutters that usually contains a great deal of litter and organic and bacterial wastes.

volatile: Evaporating readily at a relatively low temperature.

waste: (1) bulky waste--items whose large size precludes or complicates their handling by normal collection, processing or disposal methods. (2) construction and demolition waste--building materials and rubble resulting from construction, remodeling, repair and demolition operations. (3) hazardous waste--wastes that require special handling to avoid illness or injury to persons or damage to property. (4) special waste--those wastes that require extraordinary management. (5) wood pulp waste--wood or paper fiber residue resulting from a manufacturing process. (6) yard waste--plant clippings, prunings and other discarded material from yards and gardens. Also known as yard rubbish.

waste water: Water carrying wastes from homes, businesses and industries that is a mixture of water and dissolved or suspended solids.

water pollution: The addition of sewage, industrial wastes or other harmful or objectionable material to water in concentrations or in sufficient quantities to result in measurable degradation of water quality.

water quality criteria: The levels of pollutants that affect the suitability of water for a given use. Generally, water use classification includes: public water supply; recreation; propagation of fish and other aquatic life; agricultural use and industrial use.

water quality standard: A plan for water quality management containing four major elements: the use (recreation, drinking water, fish and wildlife propagation, industrial or agricultural) to be made of the water; criteria to protect those uses; implementation plans (for needed industrial-municipal waste treatment improvements) enforcement plans, and an anti-degradation statement to protect existing high quality waters.

watershed: The area drained by a given stream.

water table: The upper level of ground water.

APPENDIX E

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